Post-Flood Emergency Stream Intervention Training

Presented by
Upper Susquehanna Coalition
Stream Program

- This presentation is located on the Upper Susquehanna Coalition and NYS DEC websites:

www.u-s-c.org/ESI

or

http://www.dec.ny.gov/lands/86450.html

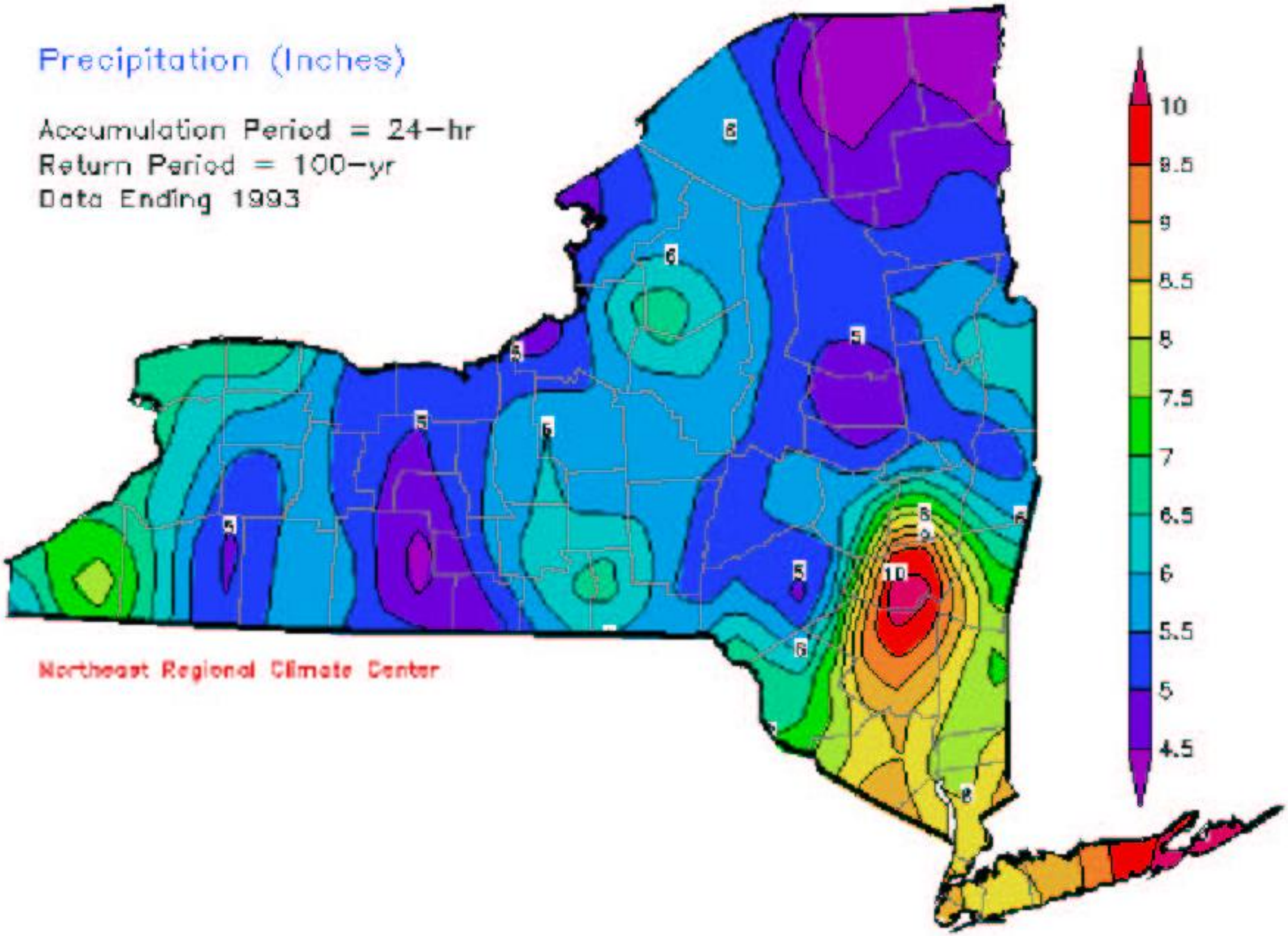
Emergency Stream Intervention

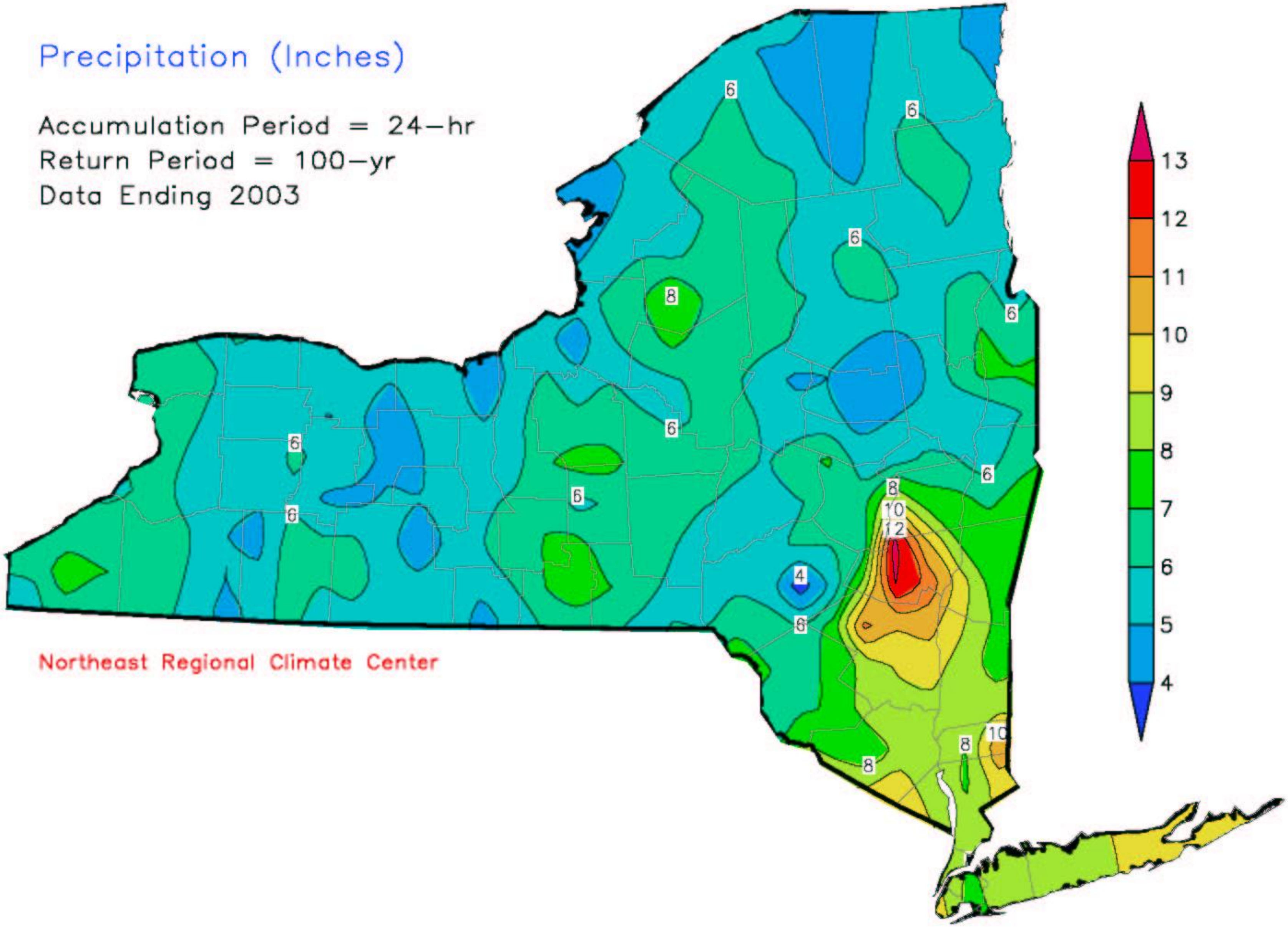
- Created in the mid-90s through a cooperative effort of NYC Watershed Initiative, Delaware County Soil & Water Conservation District, and USGS
- Developed to provide a practical tool and protocol for municipal officials and first responders to address stream channel/corridor emergency conditions to incorporate remedial practices that enhance stream transport function
- Expanded to include all of NY and currently developed for Northern Tier of PA
- Generally accepted by Federal and State regulatory agencies

Overview

- Precipitation
- Stream Mechanics
- Stream Types
- Floodplains
- Stream Instability
- Unstable Channels
- Avulsion
- Flood Response
- Channel Sizing
- Classroom Examples
- Work Methods
- Bioengineering Techniques
- Natural Channel Design Structures
- De-watering
- Questions

Precipitation


Precipitation (Inches)
Accumulation Period = 24-hr
Return Period = 100-yr
Data Ending 1993
Northeast Regional Climate Center
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5



Precipitation (Inches)
Accumulation Period = 24-hr
Return Period = 100-yr
Data Ending 2003
Northeast Regional Climate Center
13
12
11
10
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8
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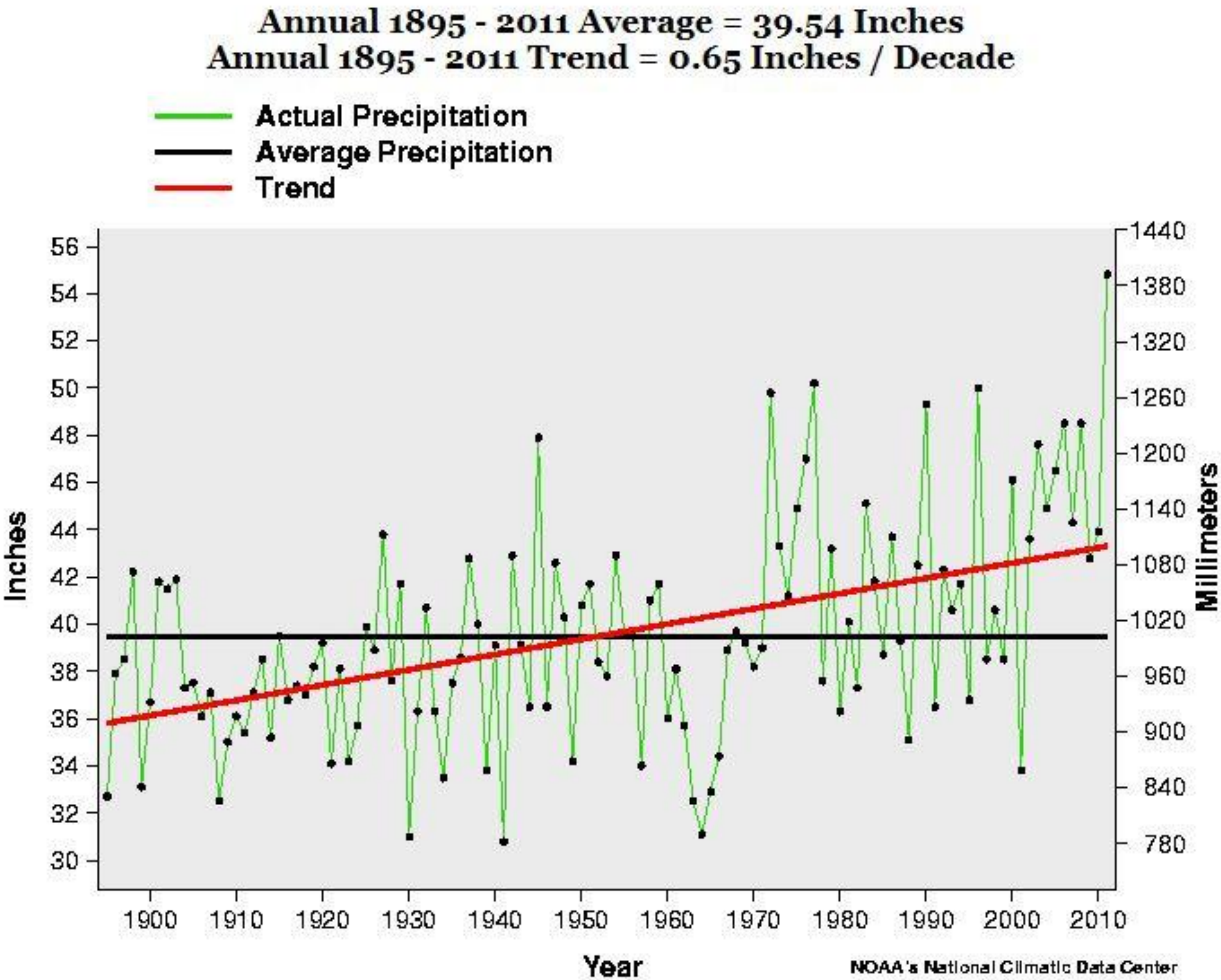
6
5
4

Climate (Precipitation)

- Climate/Weather pattern change causes increasing precipitation levels and variability (more extremes)
  - Streams are adjusting to increase flows
- Difficult to predict local severity of forecasted rain event
- Small localized storms create unique problems


Annual 1895 - 2011 Average = 39.54 Inches
Annual 1895 - 2011 Trend = 0.65 Inches / Decade
Actual Precipitation
Average Precipitation
Trend
Inches
Millimeters
Year
NOAA's National Climatic Data Center

Tropical Storm Irene

August 28, 2011

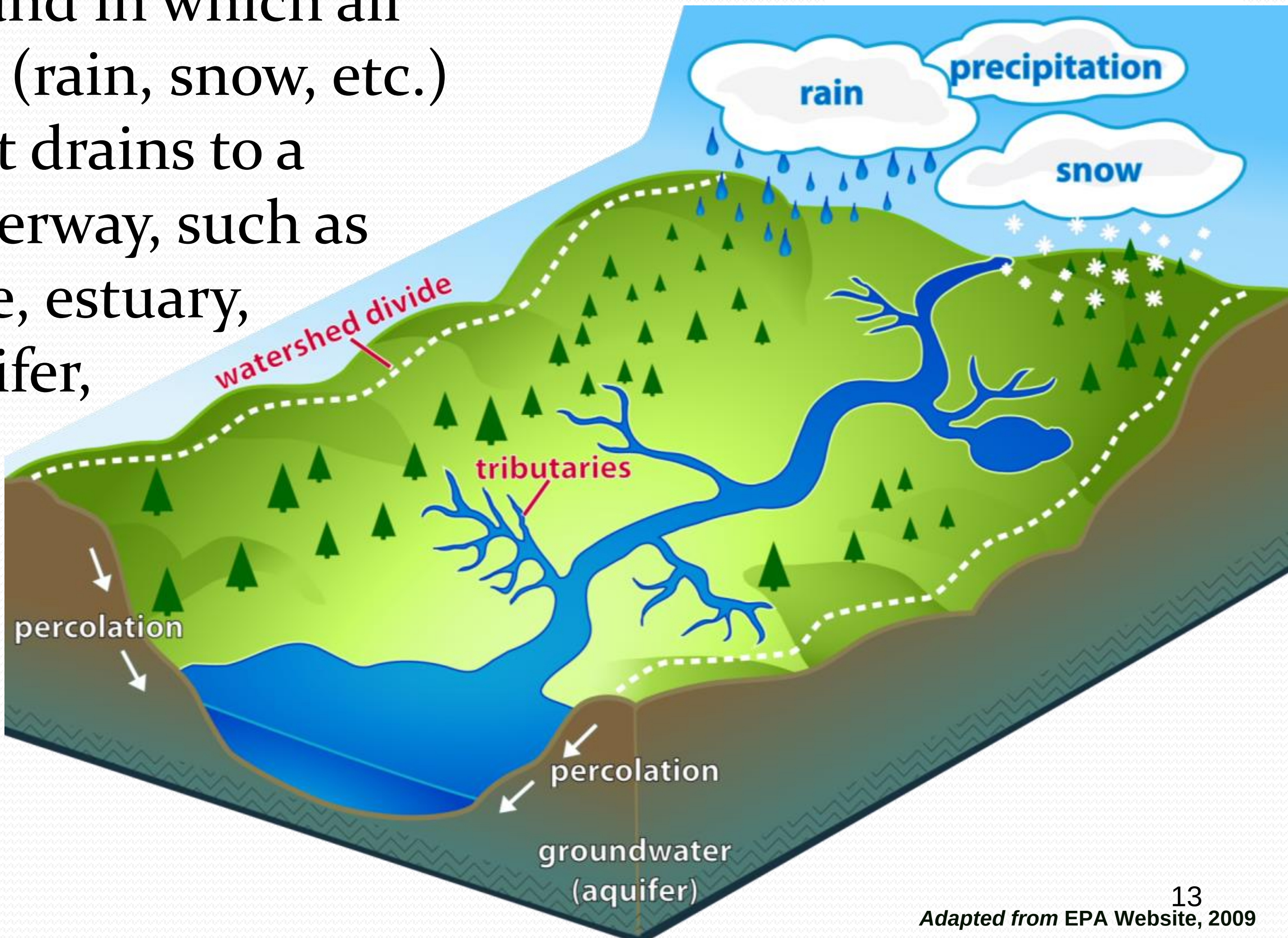
Tropical Storm Sandy

October 29,2012

Stream Mechanics

What is a Watershed?

The area of land in which all precipitation (rain, snow, etc.) that falls on it drains to a common waterway, such as a stream, lake, estuary, wetland, aquifer, or even the ocean.



Adapted from **EPA Website, 2009**

Why Do Streams Look the Way They Do?

- Geology
  - Slope
  - Soils
- Amount of water
  - Timing
  - Duration
  - Magnitude
- Landuse
  - Vegetation
  - Infrastructure

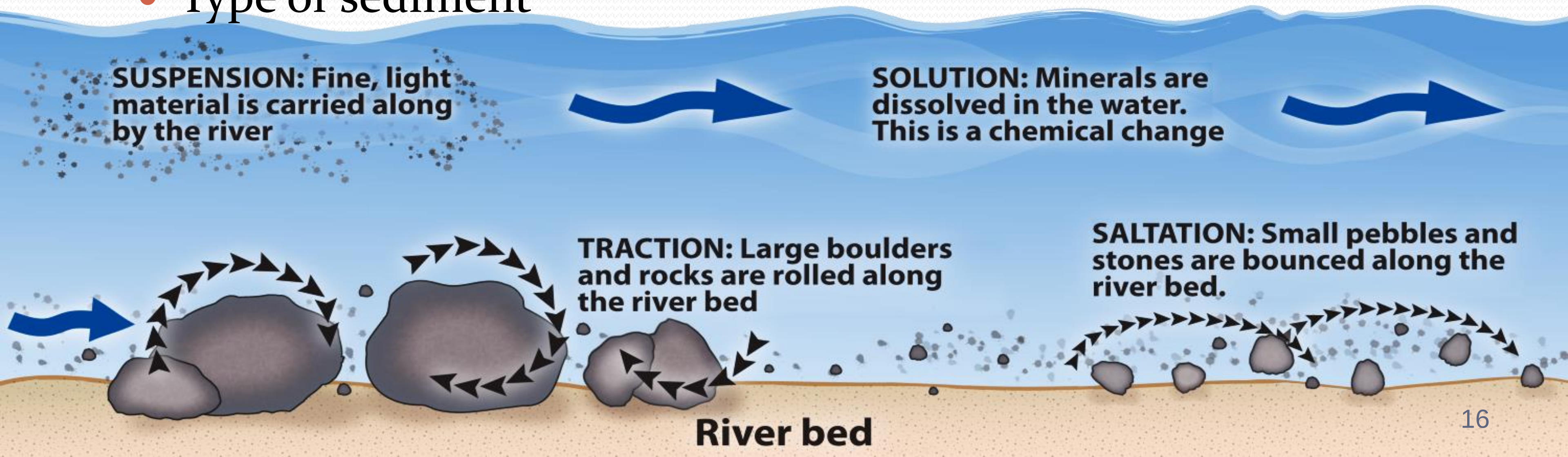
"The river is the carpenter of its own edifice"
-- Luna Leopold, 1994

Streams obey certain physical laws

- Properly size itself to transport water and sediment
- Maintain its dimension, pattern and profile

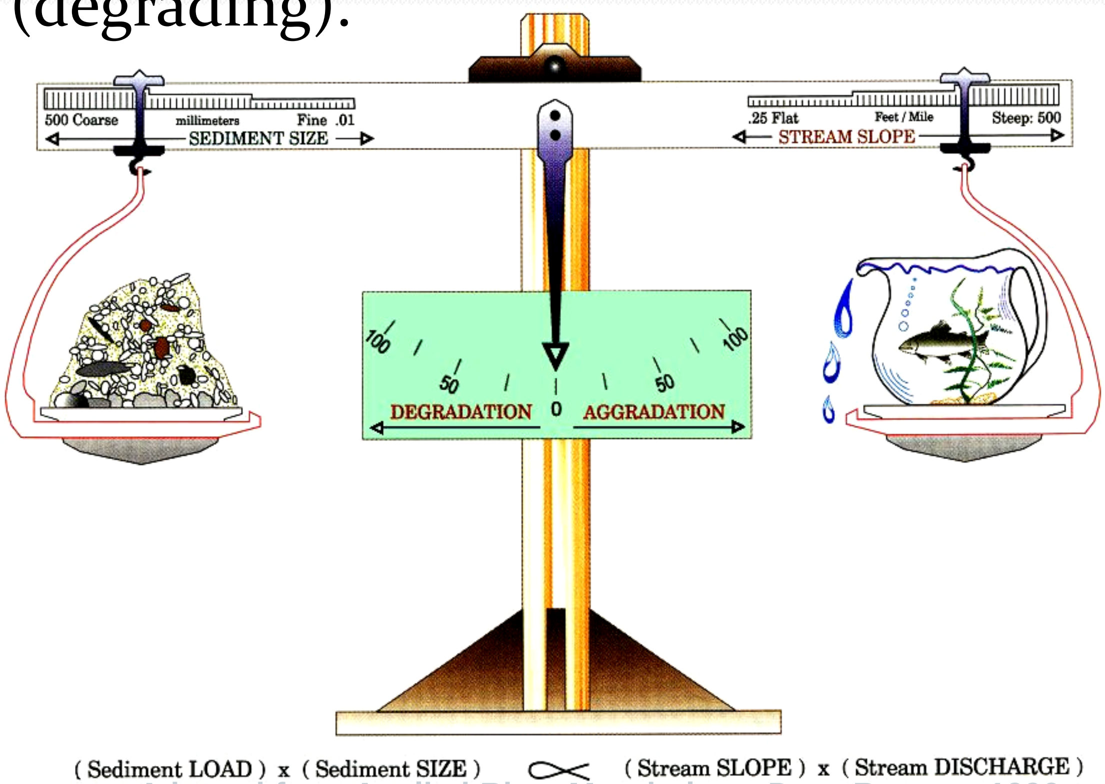
Streams Move More Than Water

- As water moves over the land it picks up sediment, forming the stream channel
- Streams create and maintain their shape and size themselves, a result of:
  - Volume of water
  - Amount of sediment
  - Type of sediment



Sediment Balance

- Streams are said to be in equilibrium when the volume of water is enough to transport the available sediment without building up the channel (aggrading) or cutting down the channel (degrading).



Adapted from Applied River Morphology, Dave Rosgen, 1996

Sediment Balance

- Based on their ability to transport sediment, streams adjust their:
  - Shape
  - Slope
  - Size

Sediment Balance

- Shear Stress
  - Measure of the force that makes the sediment move
    - The deeper the water the greater the stress
    - The steeper the stream the greater the stress

Need to take these factors into account

How does the sediment stay in balance?

- Erosion:
  - The wearing away of rocks, sediment and soils by the action of water, wind or a glacier.
    - Degradation
- Deposition:
  - The accumulation or laying down of matter by a natural process.
    - Aggradation

Examples of Erosion

- Streambank
- Mass Failures
- Lateral Migration
- Hoof shear
- Bedrock weathering

Erosion – Streambank

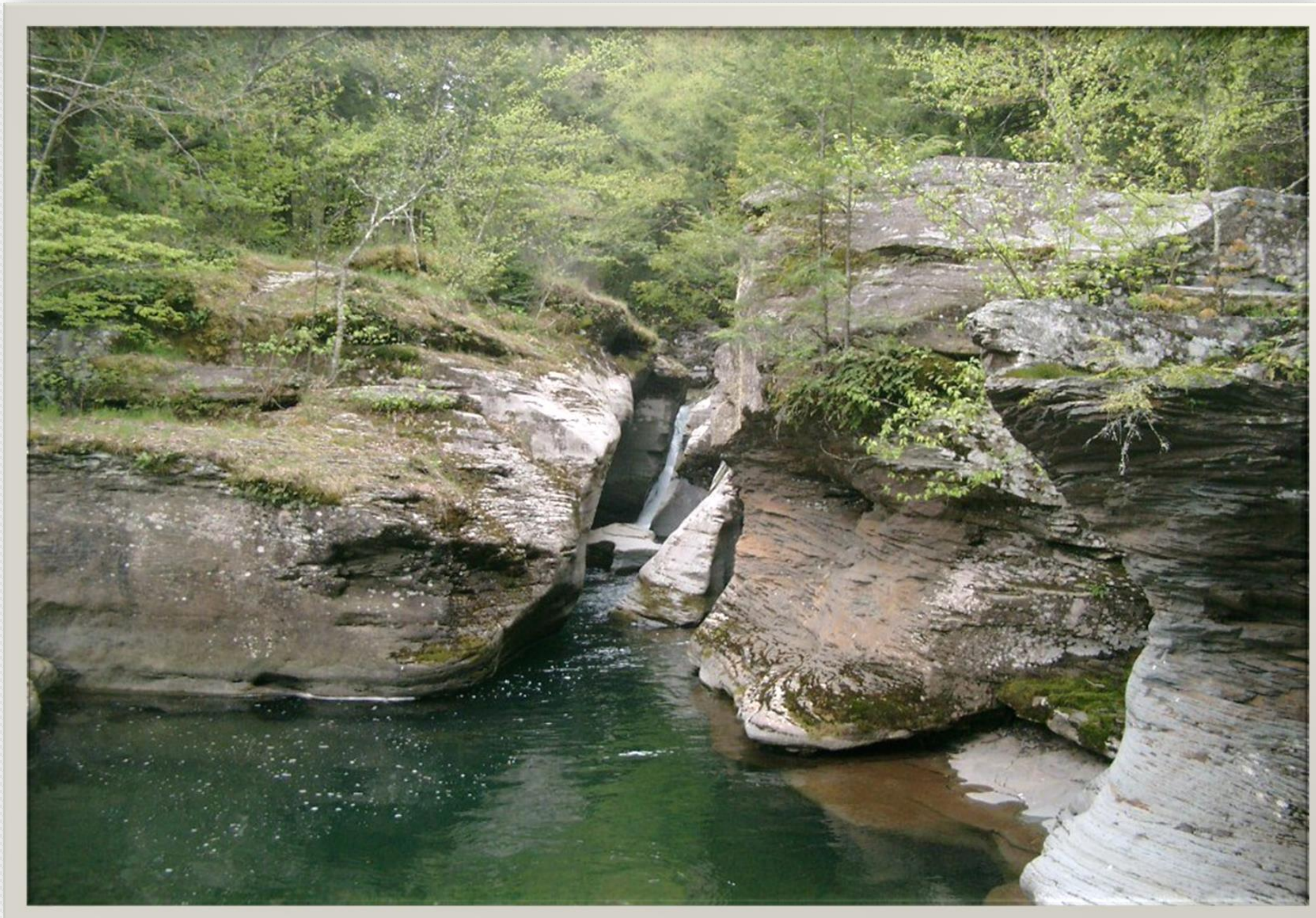
Erosion – Mass failures

Erosion – Mass failures

Erosion – Lateral Migration

Erosion – Hoof Shear

Erosion – Bedrock Weathering



Examples of Deposition

- Center bar
- Transverse bar
- Side bar
- Point bar
- Mouth of tributary
- Undersized Hydraulic Structure
- On the floodplain
- Point Bar

Deposition – Center Bar

Deposition – Transverse Bar

Deposition – Side Bar

Deposition – Mouth of Tributary

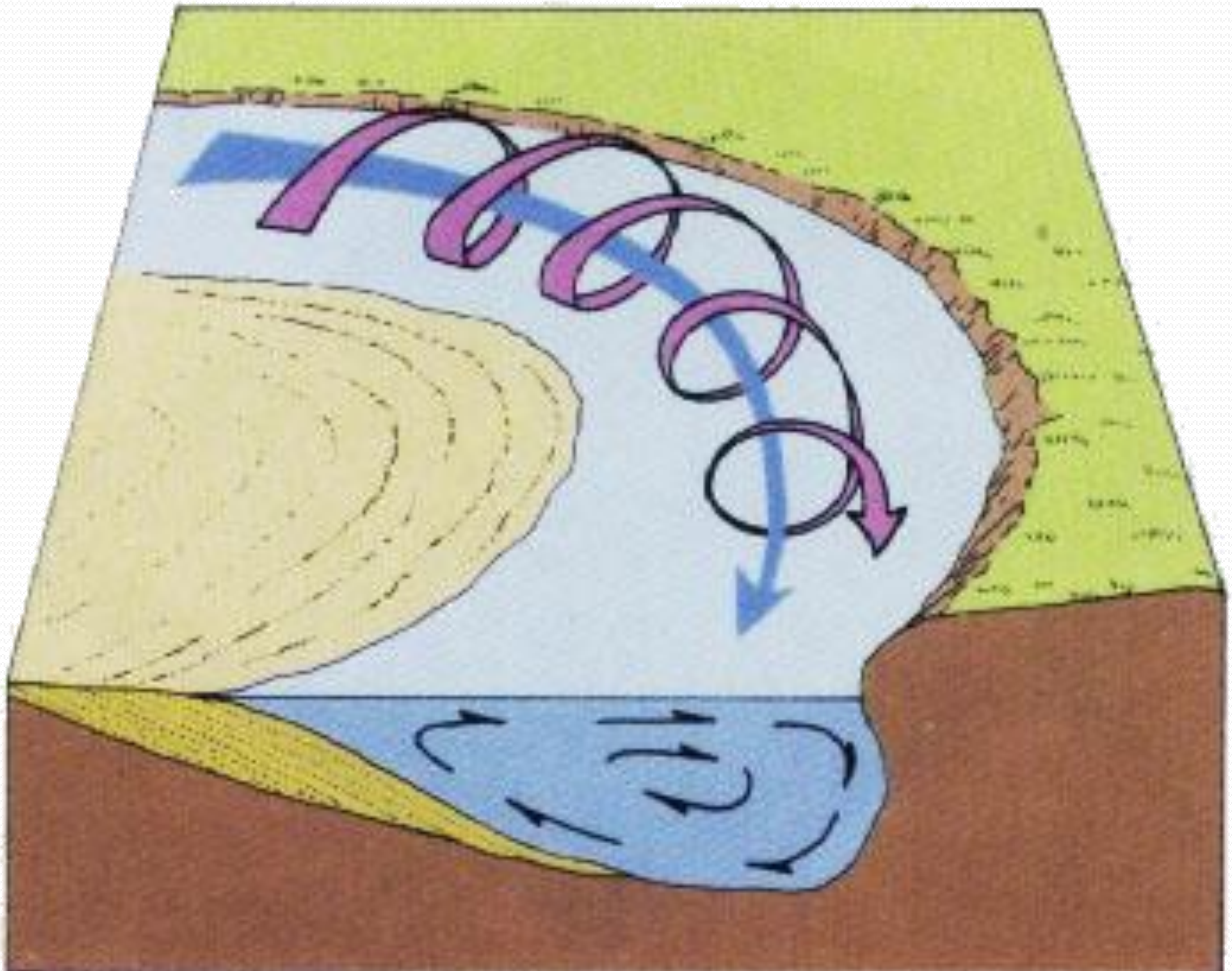
Deposition – Undersized Hydraulic Structure

Deposition – Undersized Hydraulic Structure

Deposition – On Floodplain

Deposition – Point Bar

Point Bar Formation

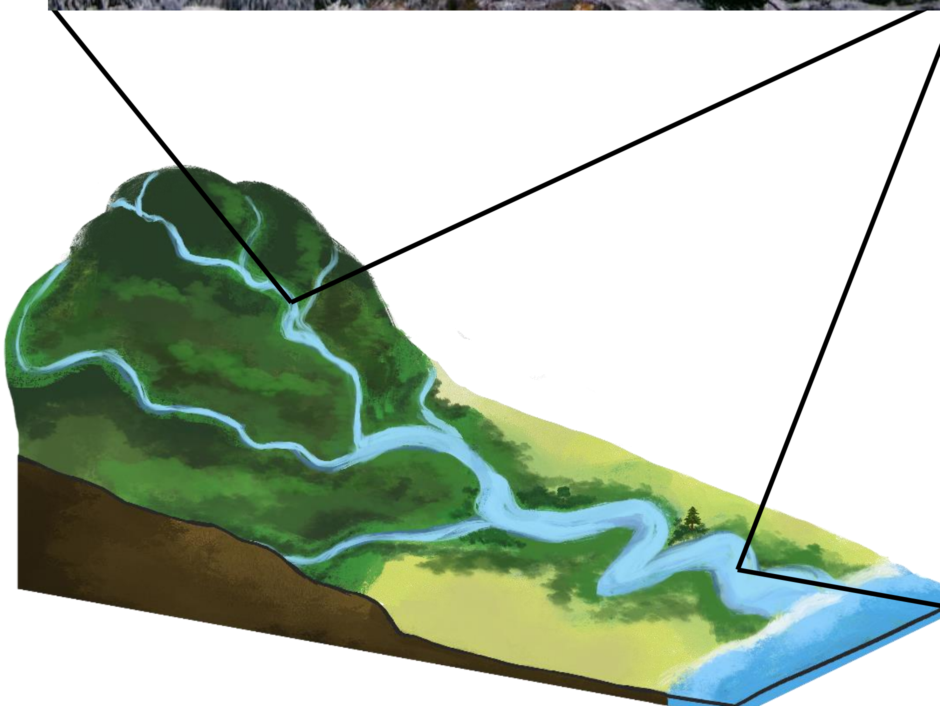


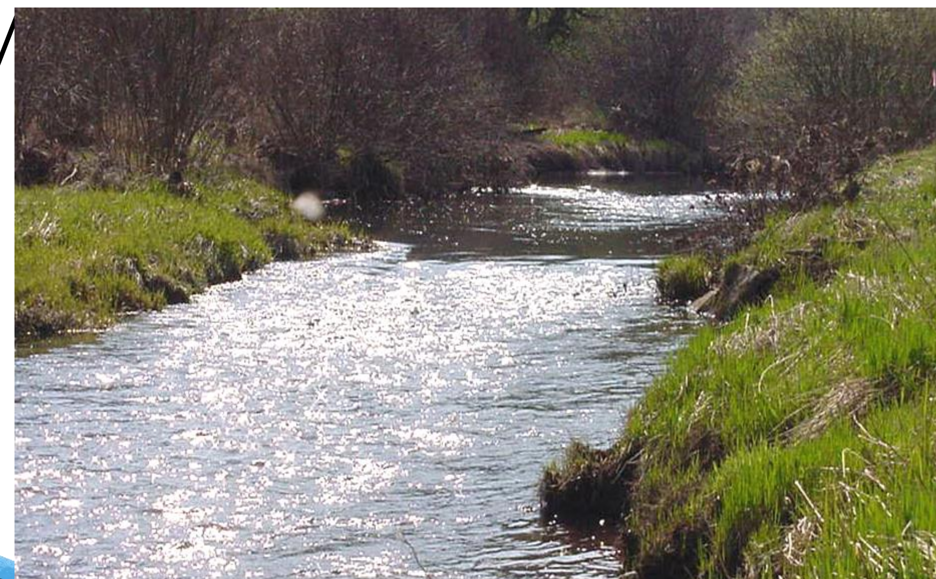
Stream Types

Two Main Stream Types

- **Step - Pool Sequence** - streams are usually found in the headwaters or on steep slopes
- **Riffle - Pool Sequence** - streams are usually found in the broad valleys and on flat slopes

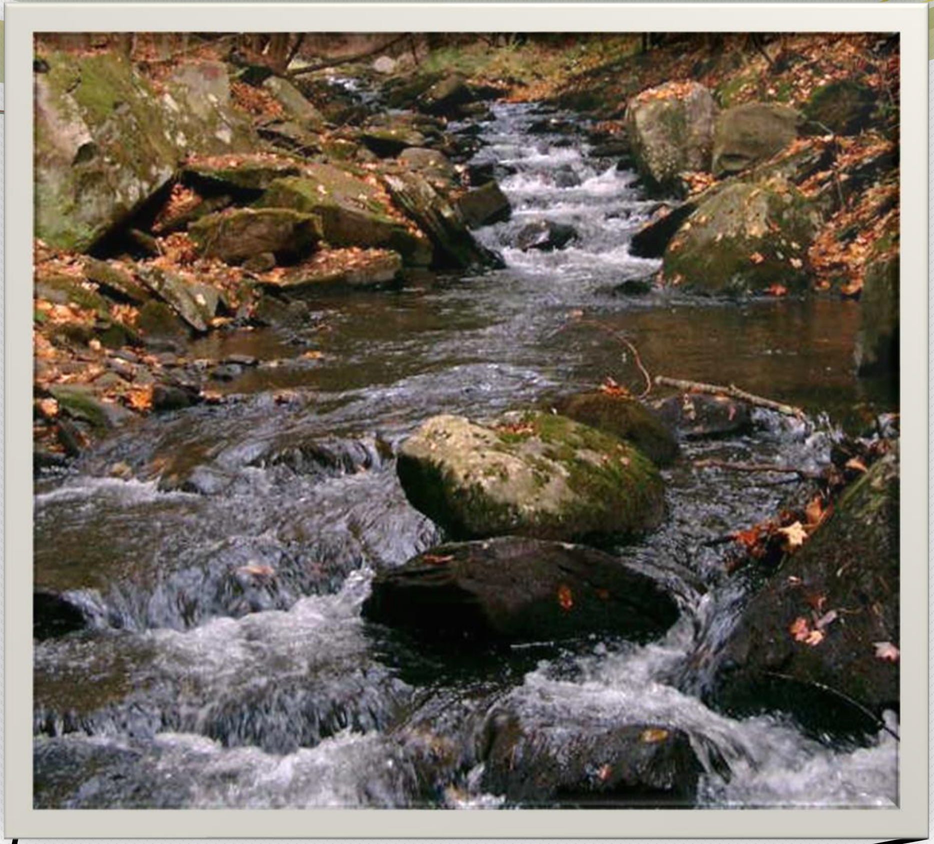
Step-Pool

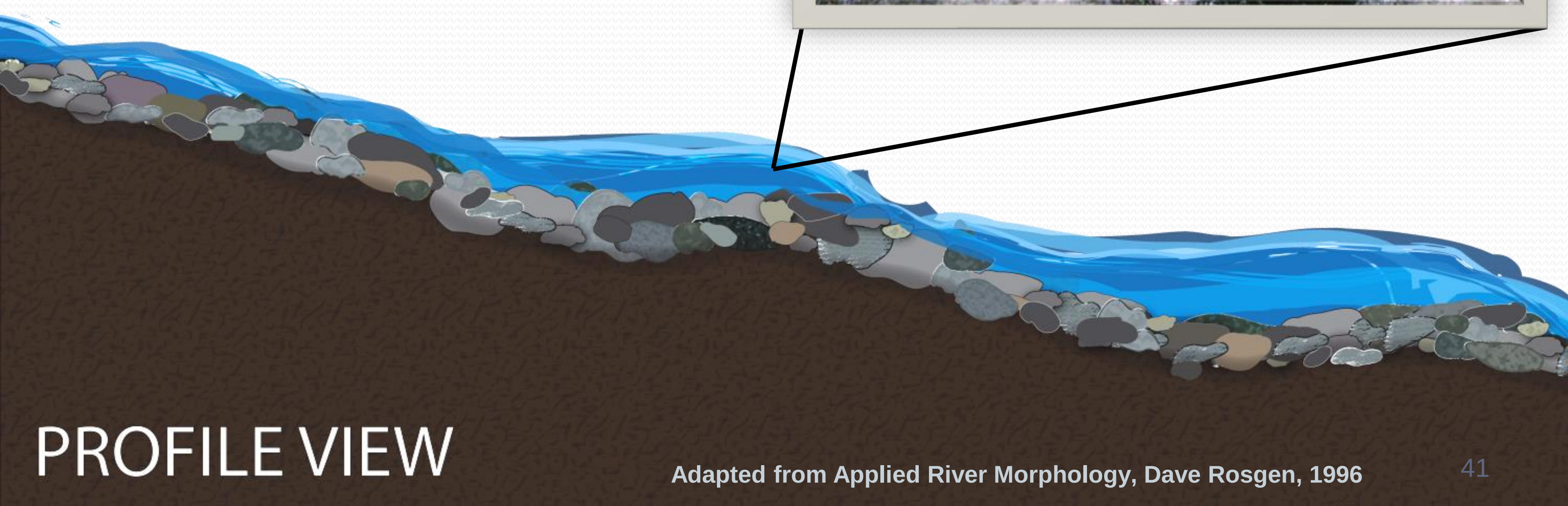




Riffle-Pool

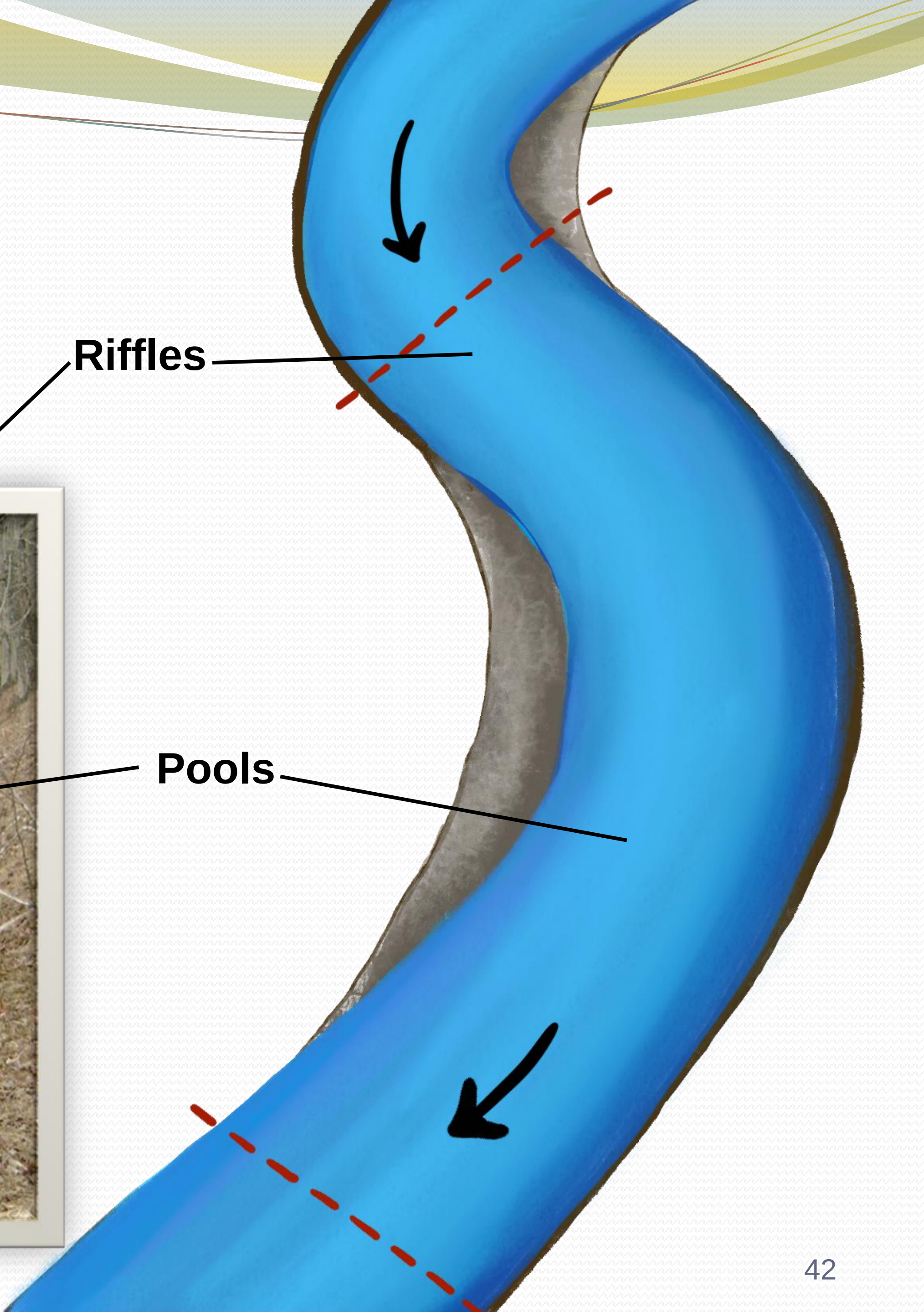
Stream Type: Step - Pool





Adapted from Applied River Morphology, Dave Rosgen, 1996

Stream Type: Riffle - Pool



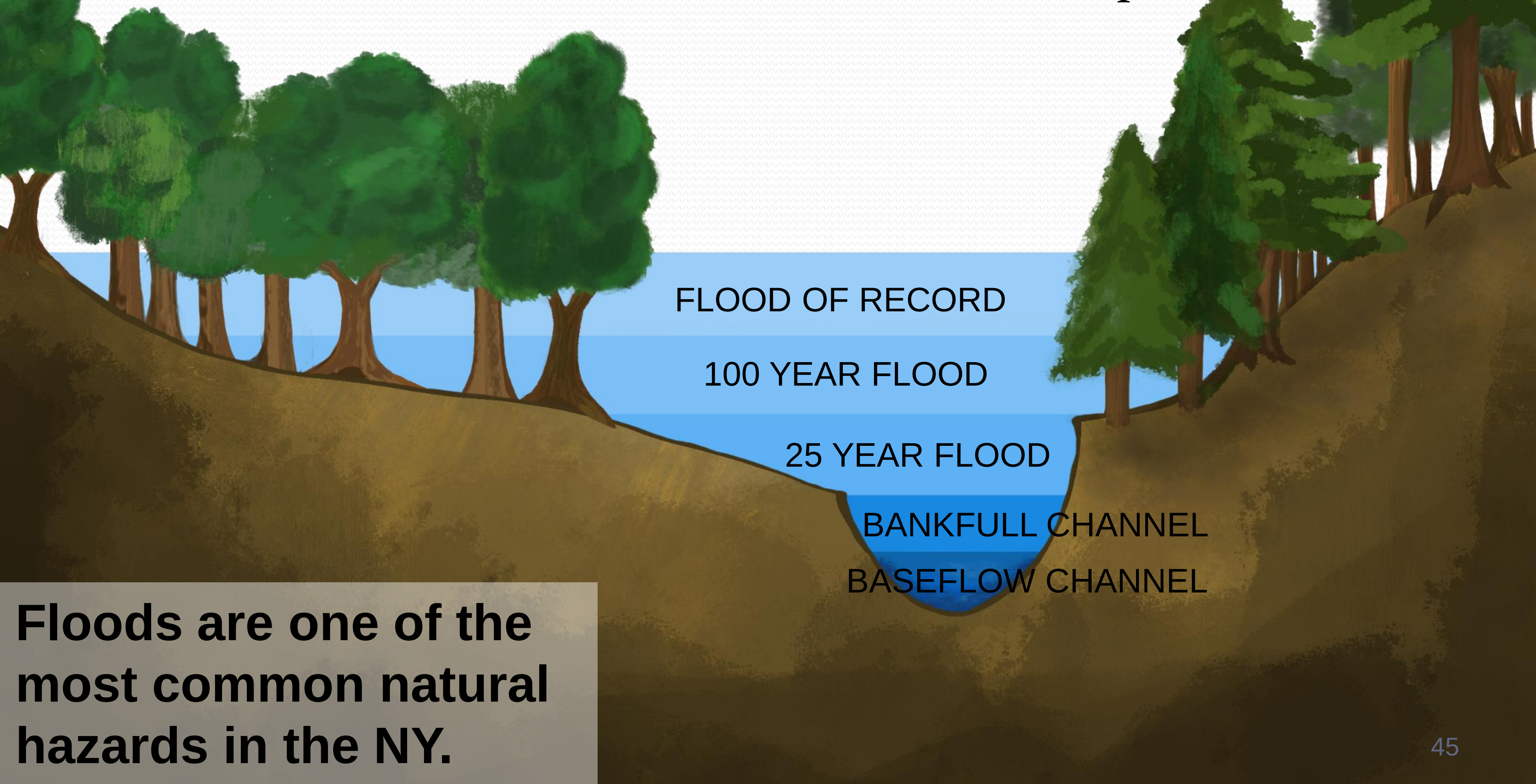
Floodplains

Floodplain Definition

- *The floodplain is the area bordering a stream, constructed by the river and inundated during periods of high flow.*

Flood Stage

When volume of water is such that the stream cannot contain the water in the channel it uses the floodplain.



Floods are one of the most common natural hazards in the NY.

Floodplain Function

- Energy dissipation during flooding events
  - Velocity and energy decreases
- Lowers flood peaks due to storage and infiltration
  - Water released more slowly downstream
- Provide a place for debris and sediment to be deposited
  - Natural process of topsoil formation

Floodplain Function – Cont.

- Reduce the flood stage (height of flood water)

- Traps fine sediments
  - Keeps that material out of the bed
  - Provides a growth medium
  - Better vegetation stabilizes the floodplain

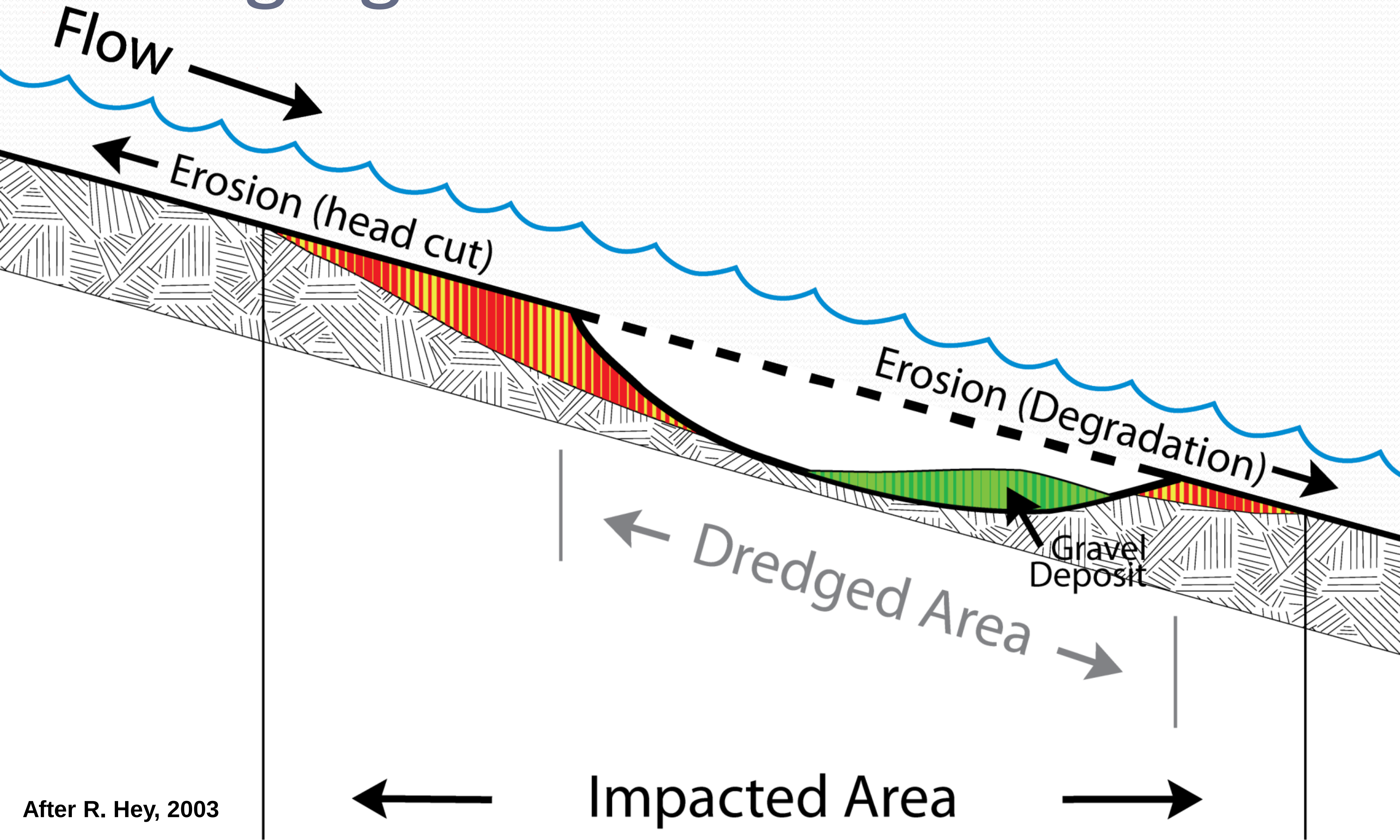
Ouleout Creek near Franklin, NY – 2006

Stream Instability

How do streams become unstable?

- Dredging
- Channel Straightening
- Berms
- Disconnecting floodplain from the channel
- Development on the Floodplain

Dredging

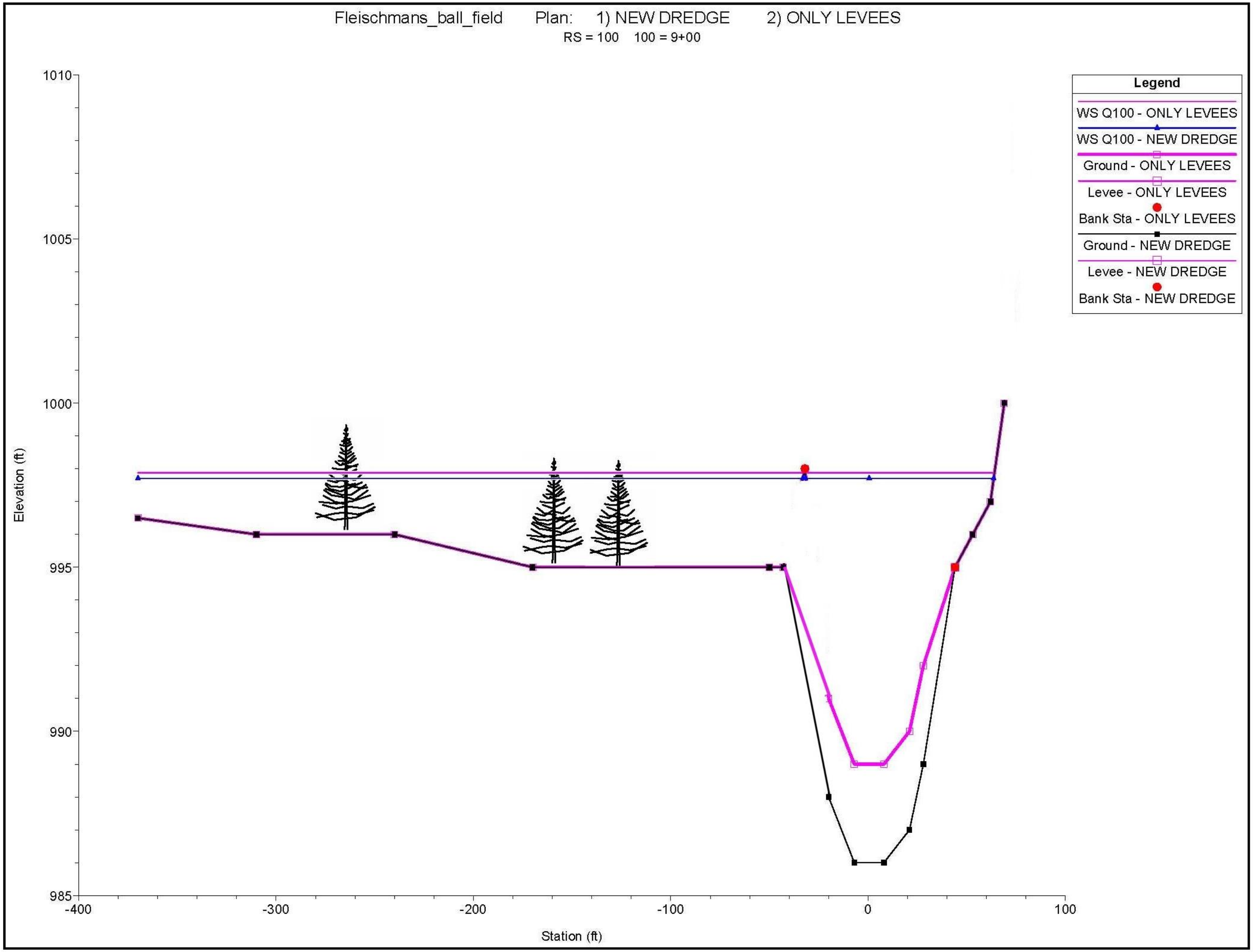


After R. Hey, 2003

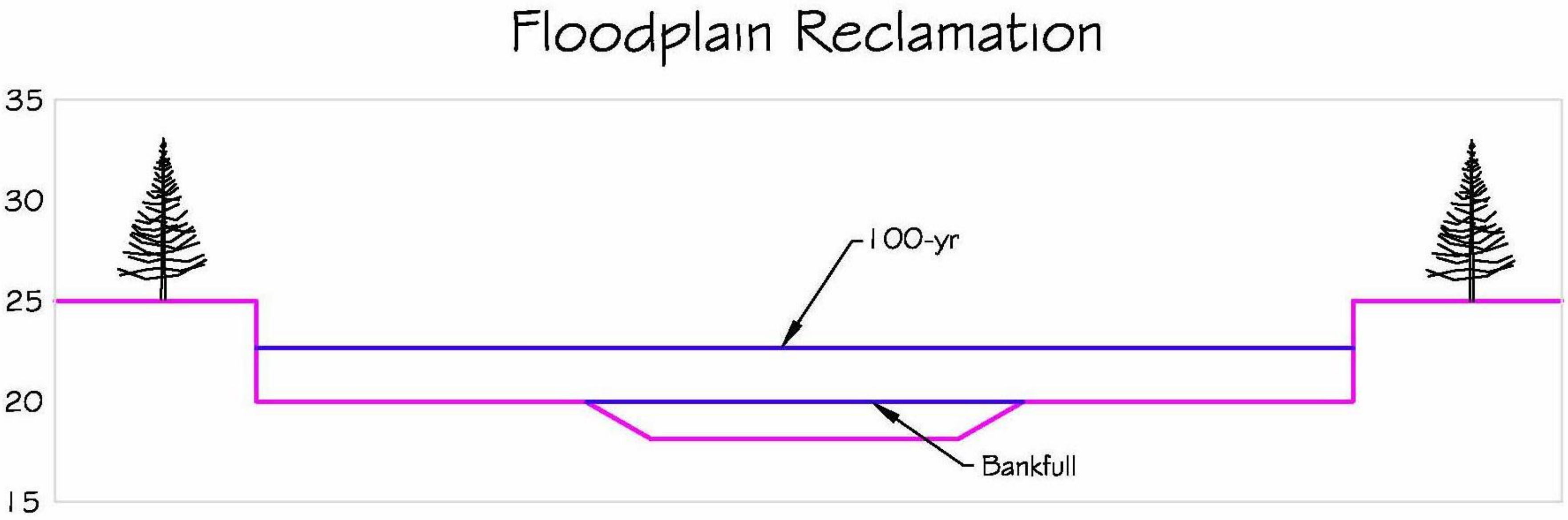

KOMATSU
PC300LC


Steep riffle
Erosion
Channel is too wide
Gravel Deposition

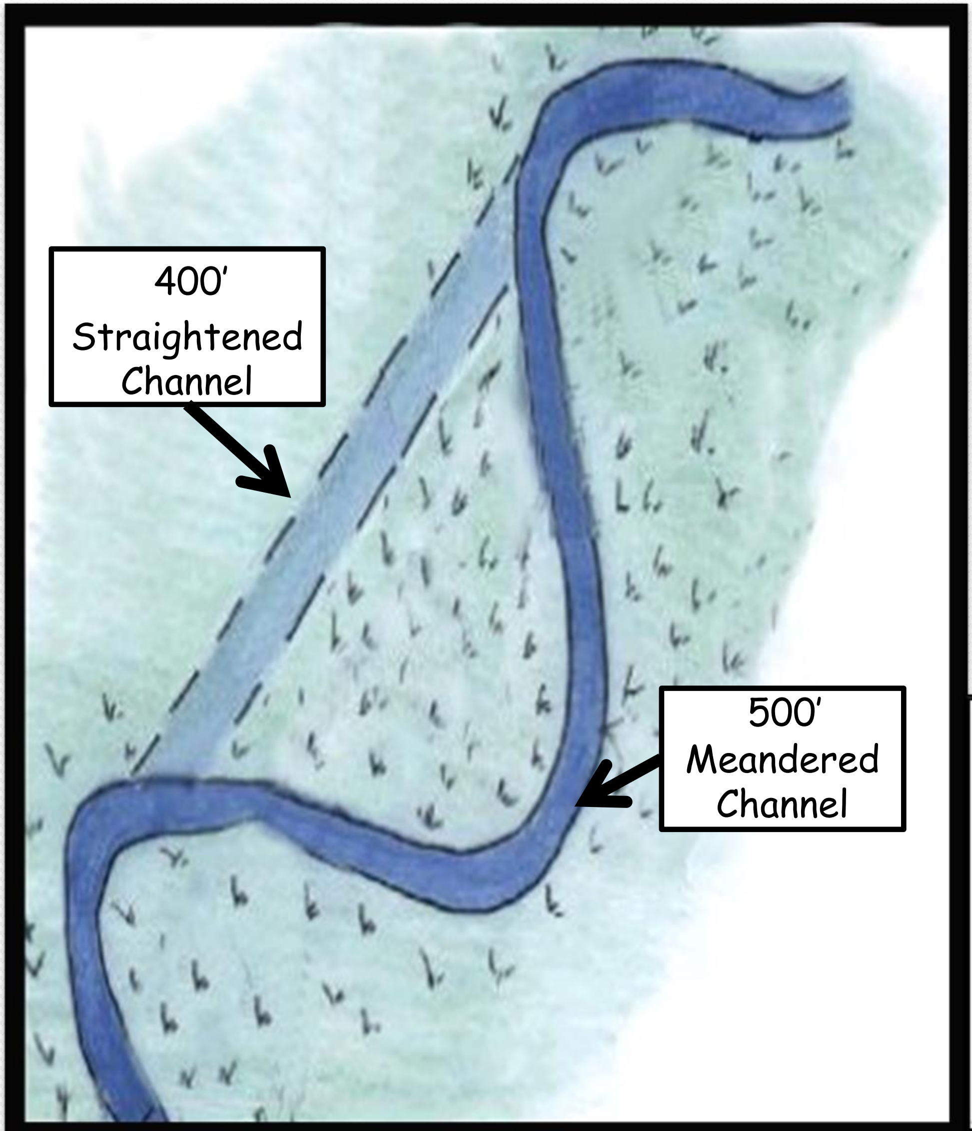
Does Dredging help flooding?



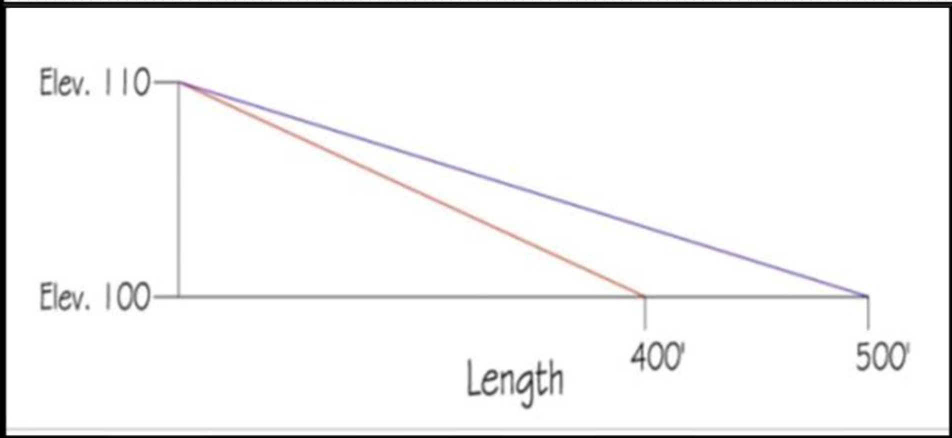
Channel Modifications



Channel Straightening



- Shorter distance means a steeper slope
- A steeper slope increases velocity
- A steeper slope increases erosion on the streambank and bed



Channel Straightening

Channel Straightening

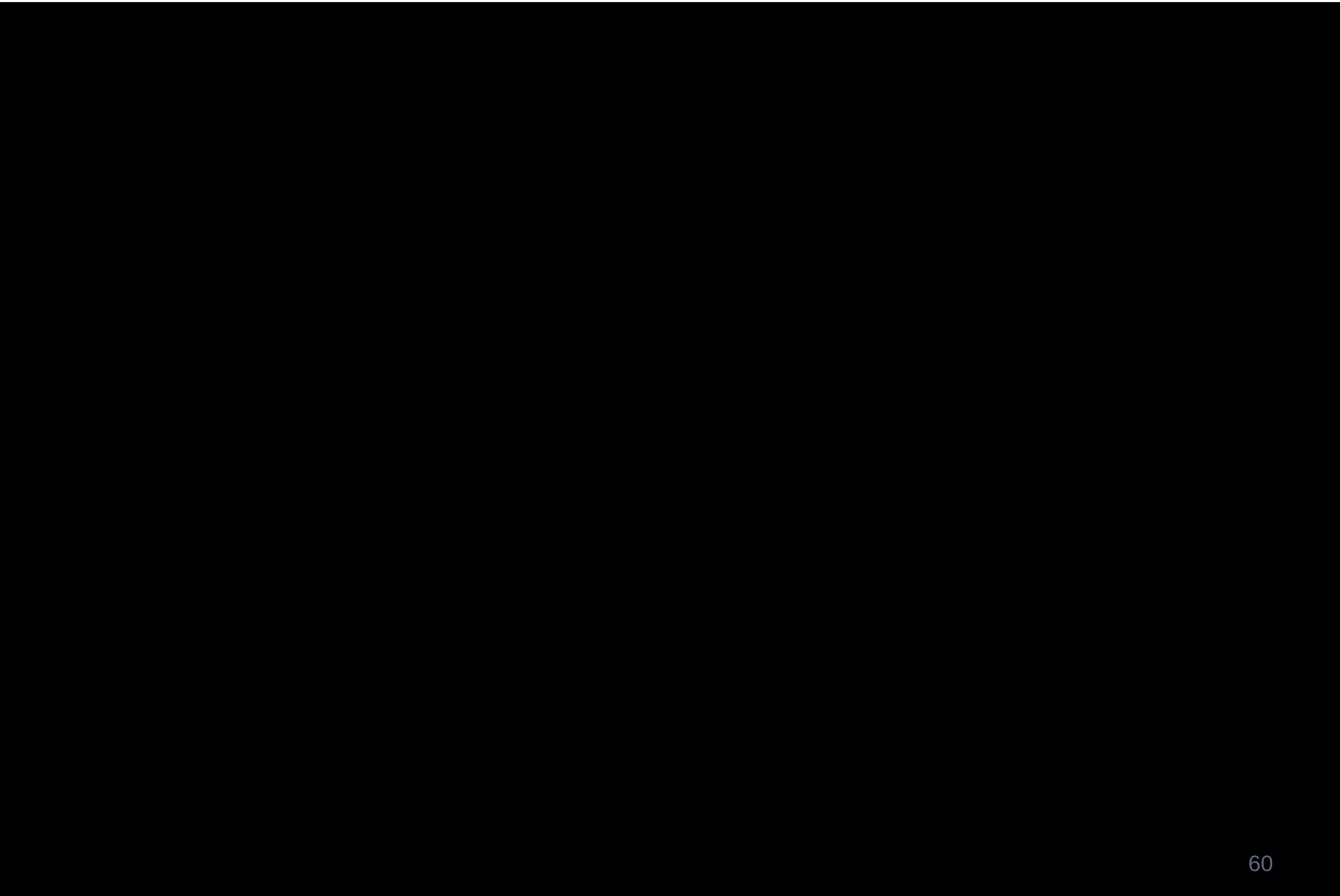
Channel Straightening - Repair

Stream Table Demo

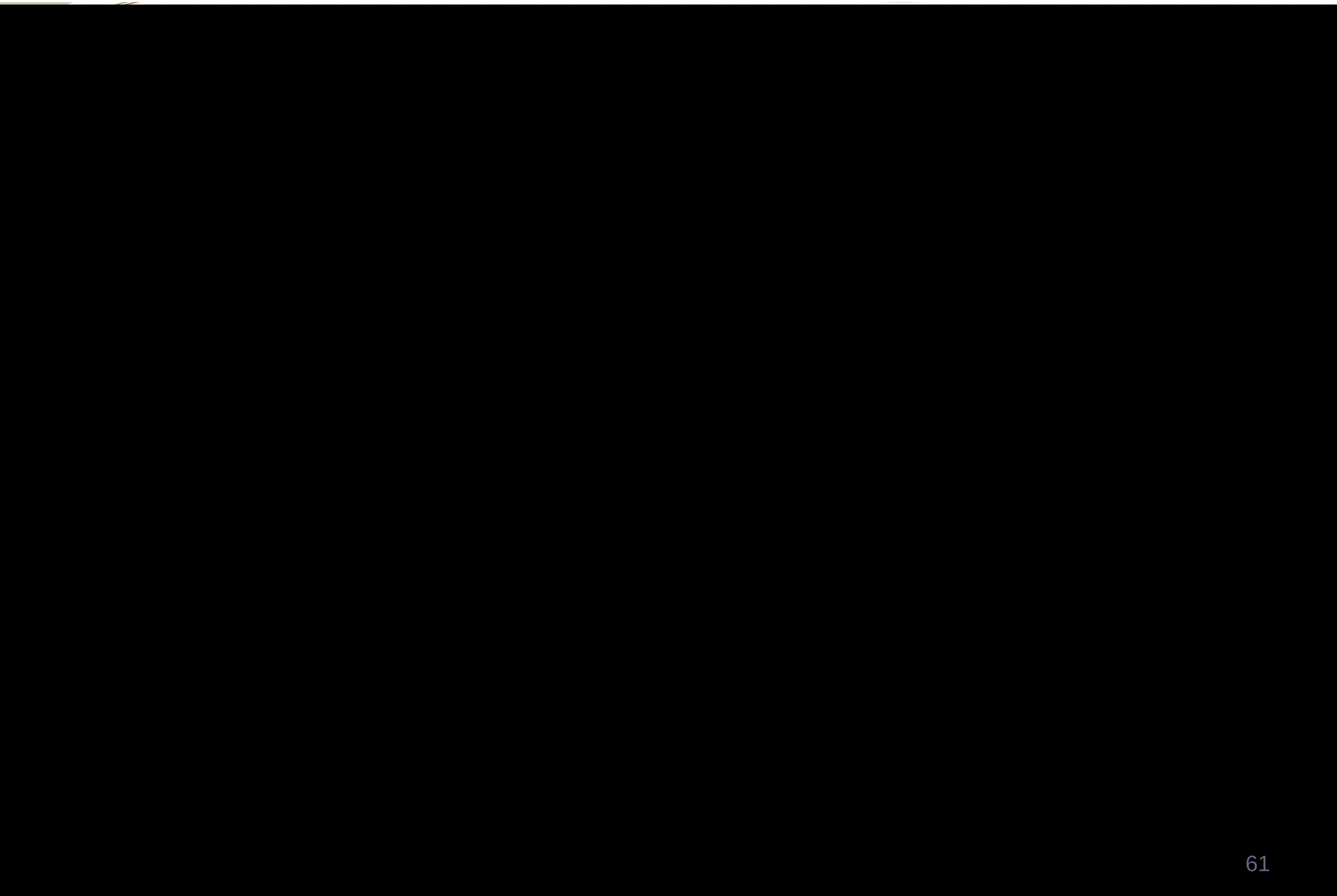
Straightening

Dredging

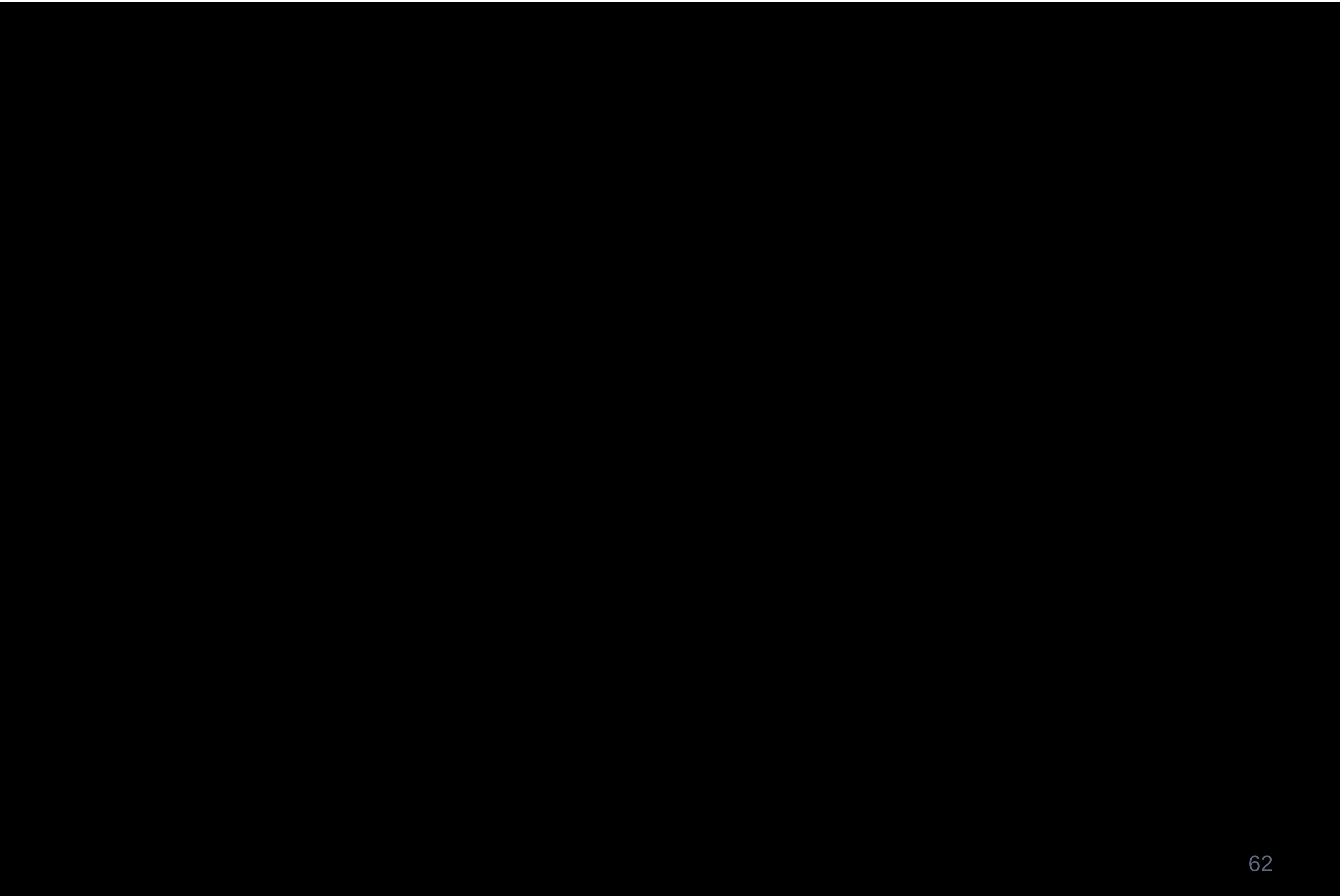
Stream Channel Straightening



Dredging

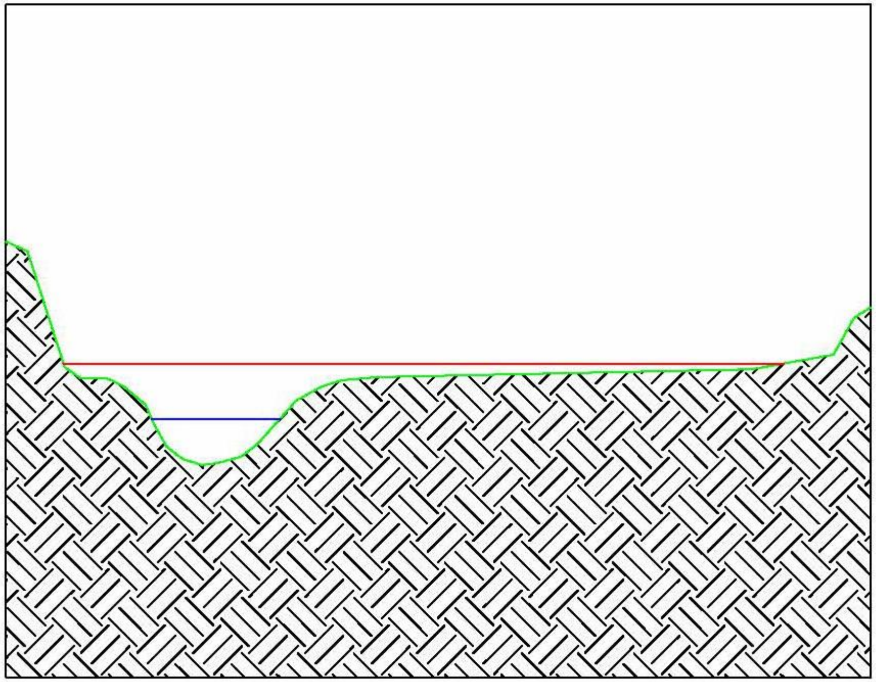


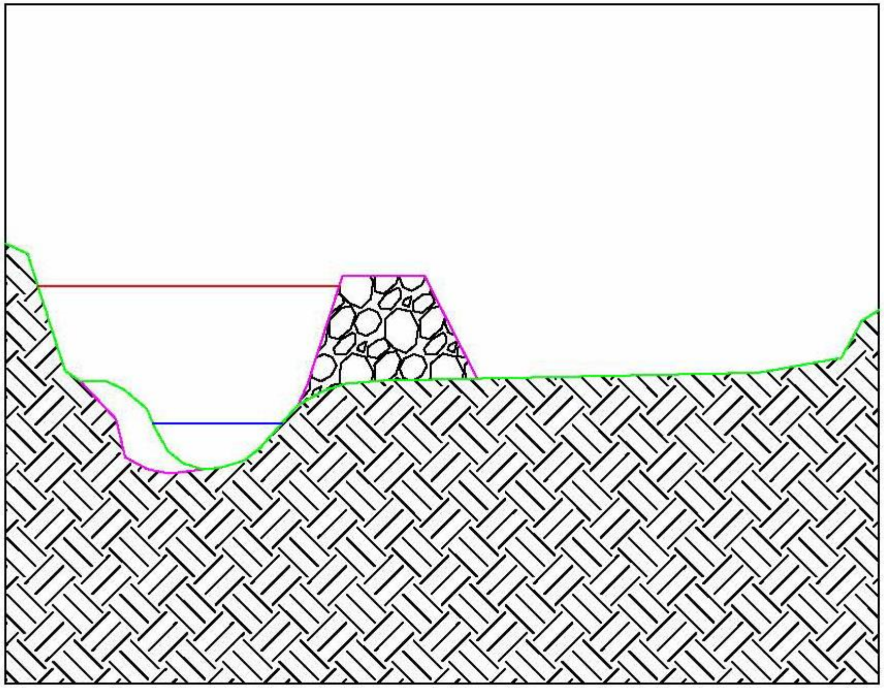
Another Example of Dredging



Berms Definition

An earthen embankment or wall, usually built to provide protection or a result of side casting during stream channel dredging





Berms

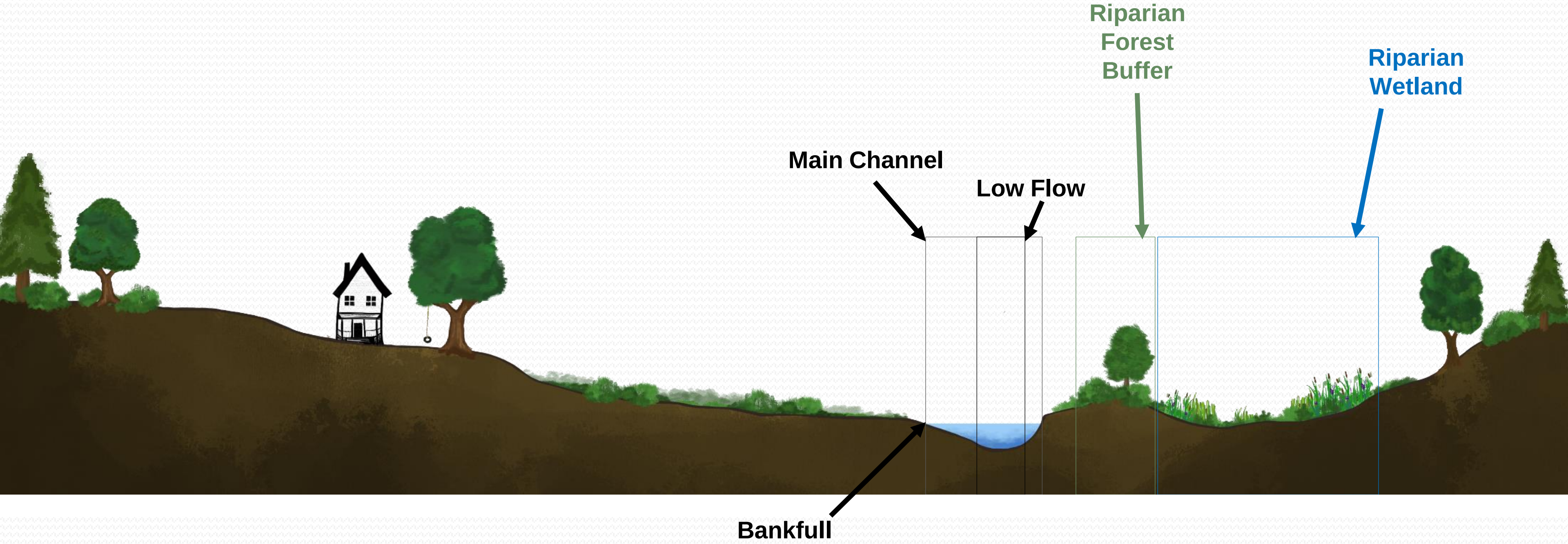
Berms

Berms – Failure

Berms – Failure

Floodplain

The floodplain is part of the river during storm conditions



Floodplain

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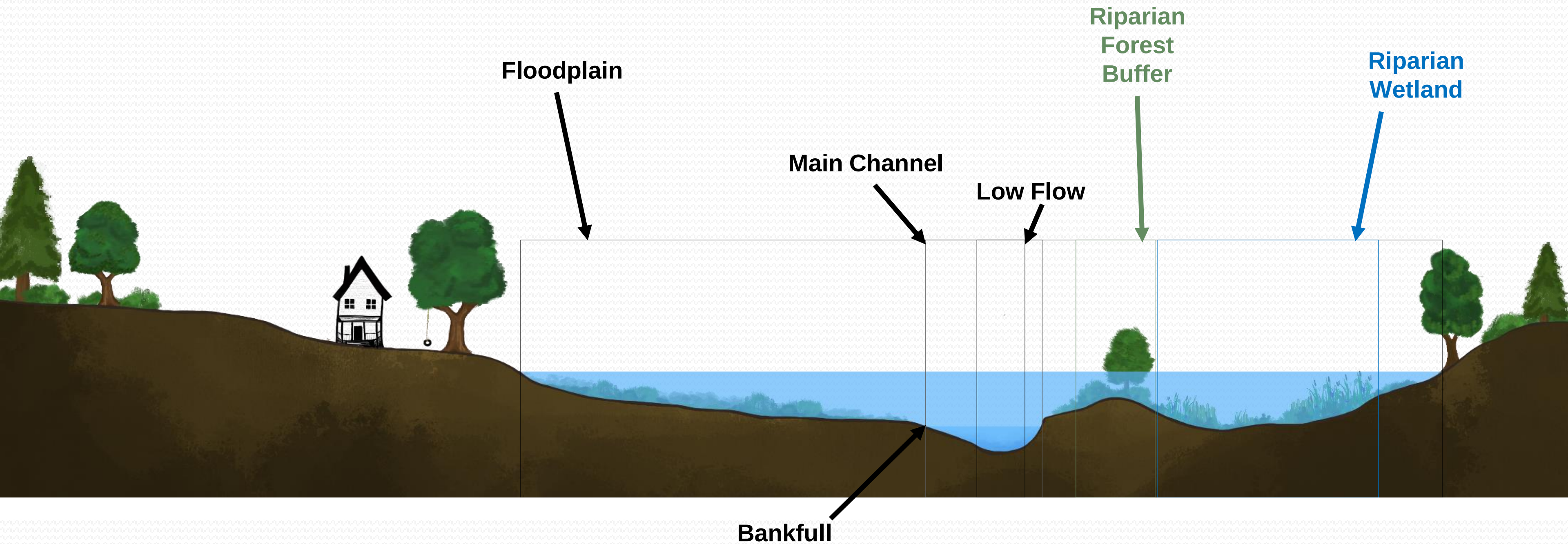
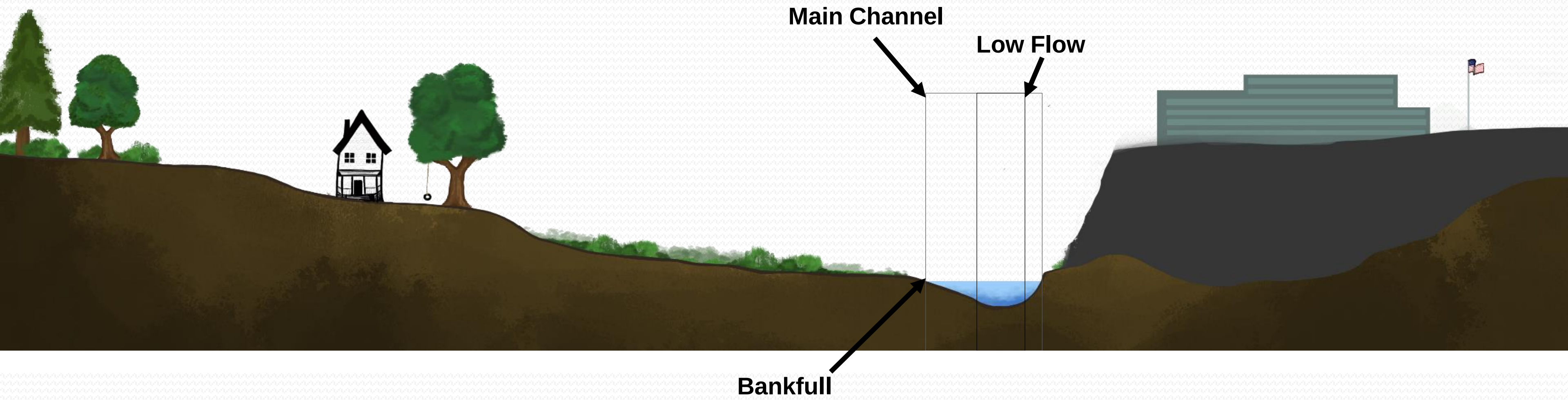


Today's Floodplains are not necessarily Tomorrow's floodplain

If large areas of the floodplain are filled, then there will be an increase in the land area needed to store flood waters. This means your home, farm, or business may be impacted.



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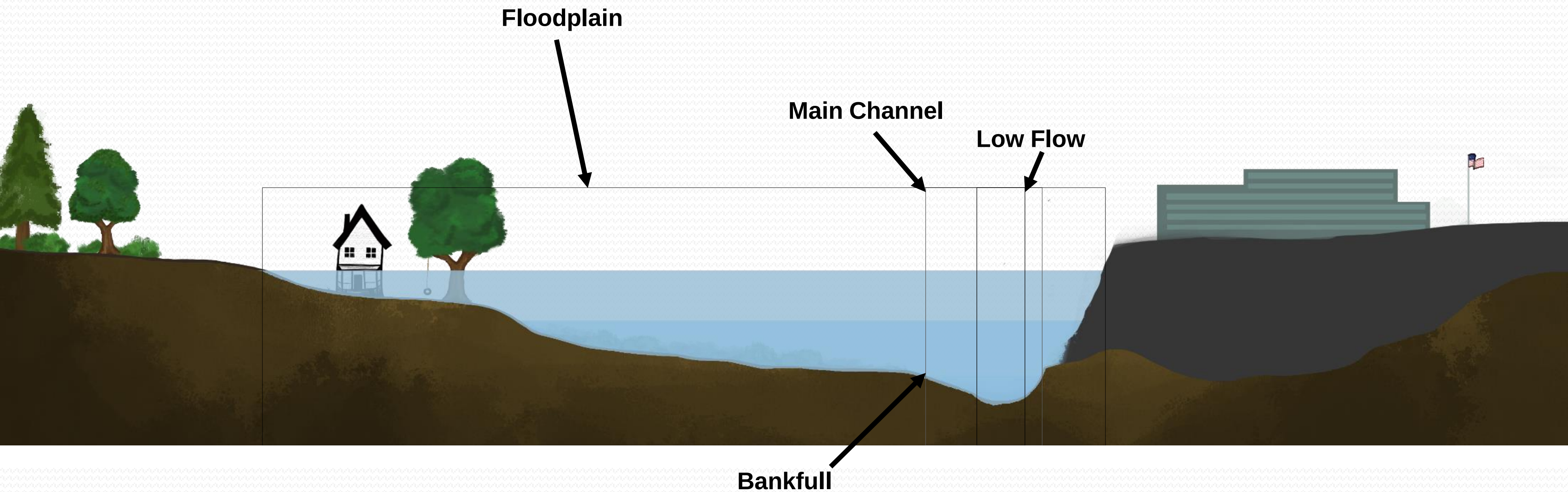


When the channel is disconnected from the floodplain…

- Velocity and energy of Stream increases
- Erosion increases
- More damage to infrastructure from debris
- The flood stage is higher

Filling in the floodplain

Development on the Floodplain

- Buildings
- Bridge approaches
- Roads
- Parking lots
- Etc.

When the floodplain is developed…

- More threat to life and property
- Velocity and energy increases
- Erosion increases
- More damage to infrastructure
- The flood stage downstream is higher
- Higher cost of flood damage
- Increased flood insurance


Development on the floodplain can lead to significant stream issues including erosion & infrastructure damage


CVS/pharmacy
Freshtown
MARKETPLACE
08/28/2011


CVS pharmacy
Fresh
08/28/2011


NOW & THEN VIDEO


RESTAURANT

Unstable Channels

General Channel Responses to Instabilities

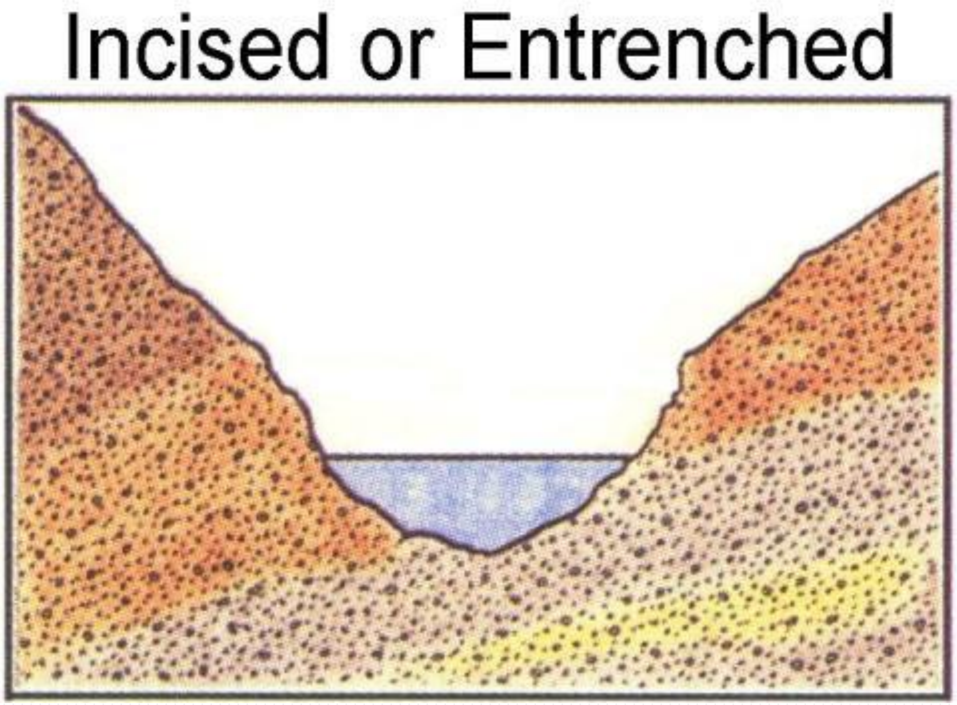
- Instability progresses **downstream** when there is a change in local sediment supply
  - **Increased supply** (landslide or gravel rich tributary) results in deposition downstream
  - **Decreased supply** (as from a dam or concrete or heavy stone lined channel) results in downstream erosion

General Channel Responses to Instabilities

- Instability progresses **upstream** when there is a change in local channel form
  - **An incised channel** (dredged or severely down-cut) results in bed erosion upstream
    - Usually in the form of a head-cut
  - **An aggraded channel** (as from a dam or overly wide) will result in deposition upstream

Incised or Entrenched Channels

- Streams that cannot access their floodplain at the bankfull flow are said to be incised or entrenched
- Incised streams display high velocities & erosive forces during floods
- Incised streams are almost always unstable

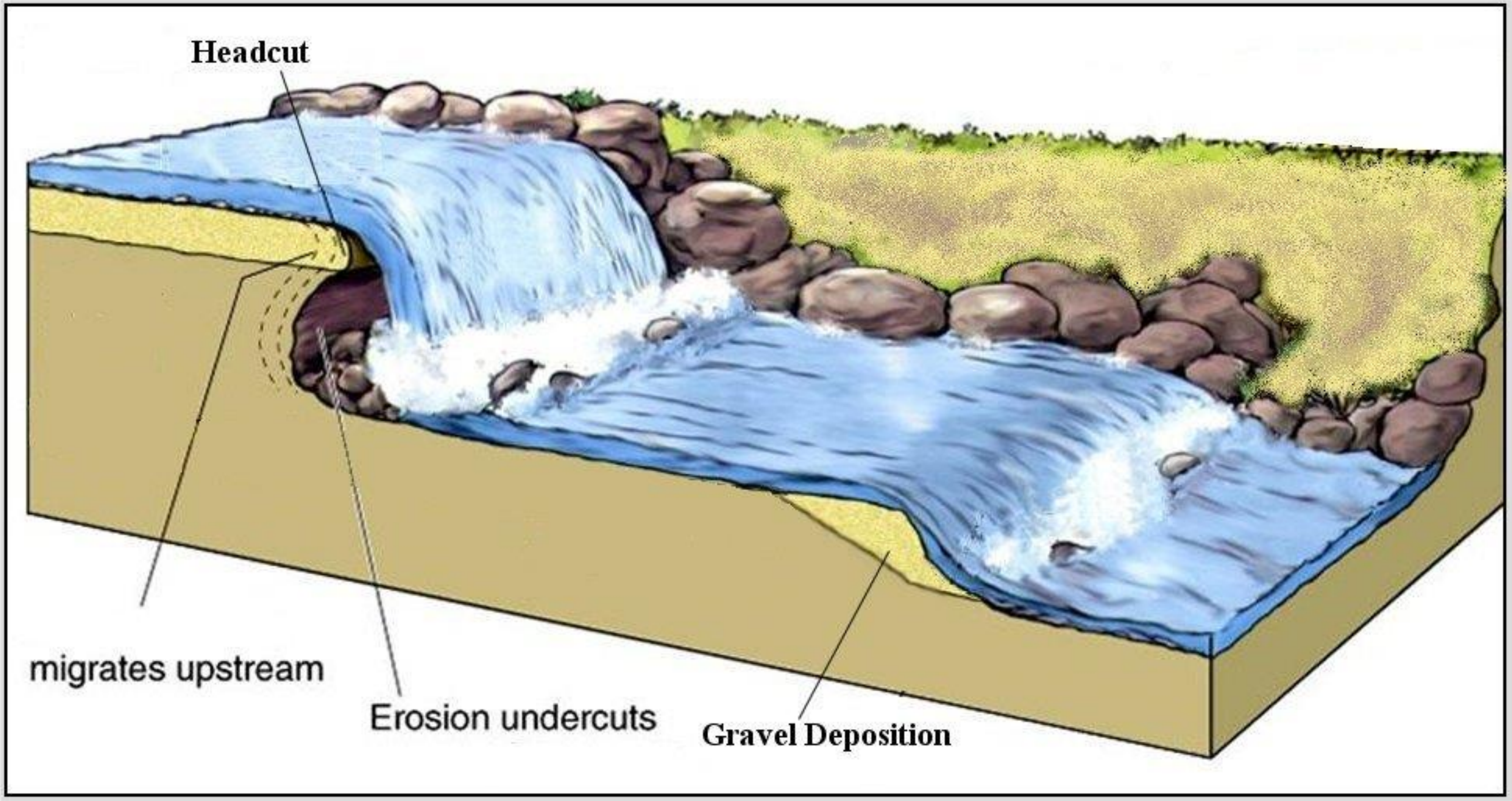


After Rosgen 1996


07-05-07

Headcut Definition

- Instability that progress ***upstream*** and ***downstream*** from a local disturbance.

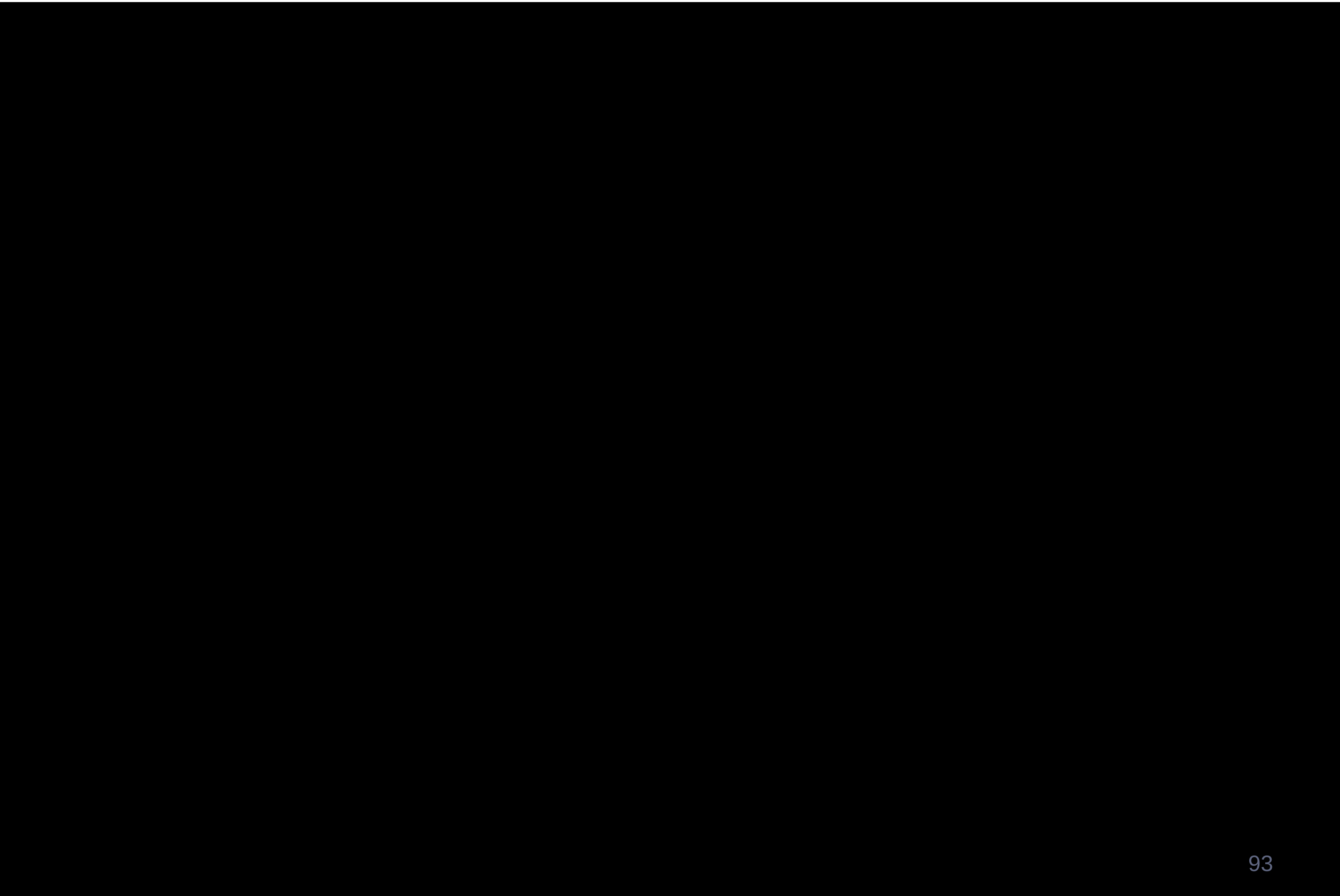


Headcut

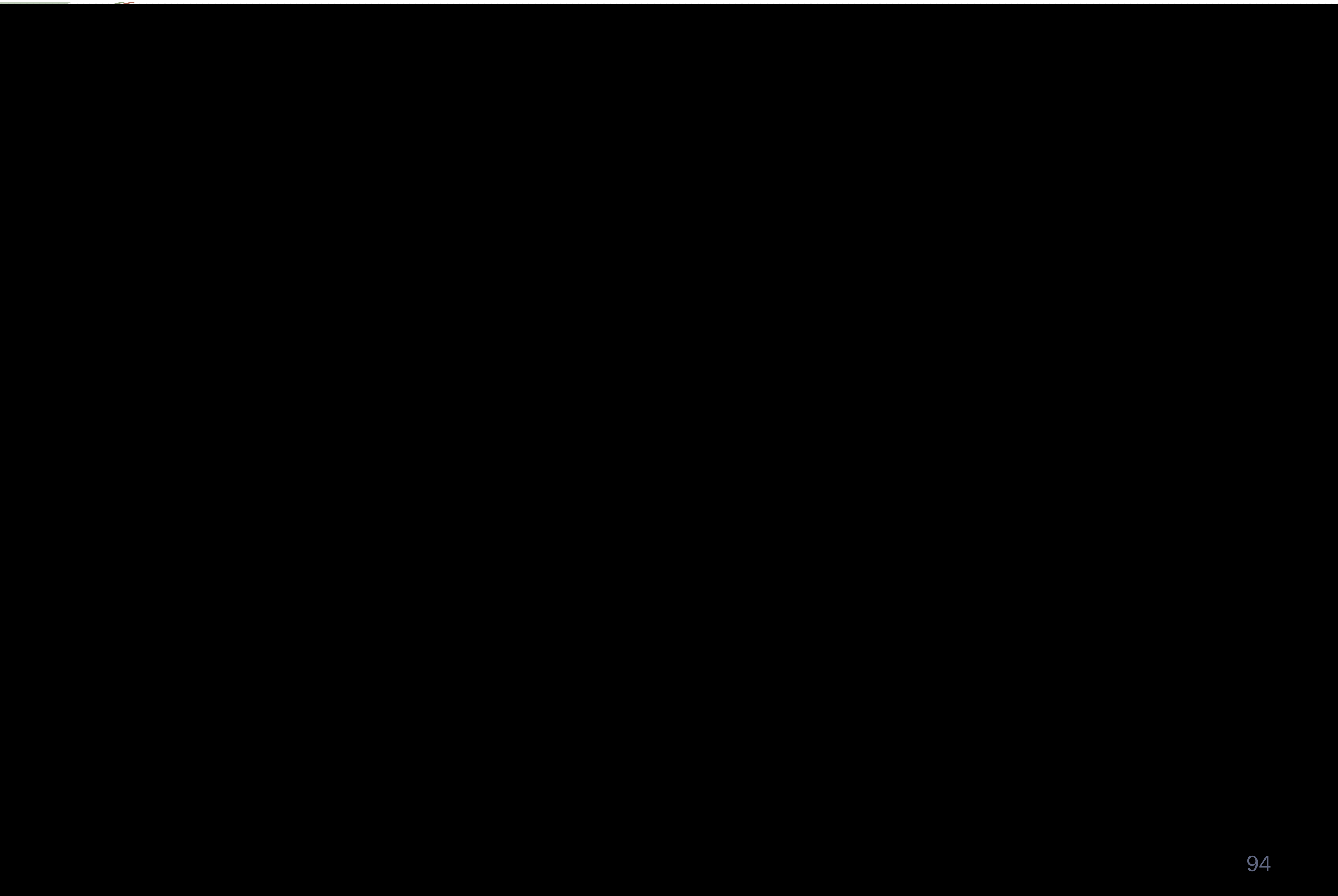
Stream Table

Headcut

Headcut in Profile



Headcut & Floodplain Disconnect



Avulsion

Avulsions Definition

- Avulsions are where the stream is no longer in its original channel
- Is it …
  - A threat to water quality ?
  - A threat to property?
  - A better alignment?
- Is it possible to work with this new alignment?

Avulsions

- Do **NOT** work if there is no immediate danger to property or necessary infrastructure
- *Notify the municipality and local SWCD that there is an avulsion*

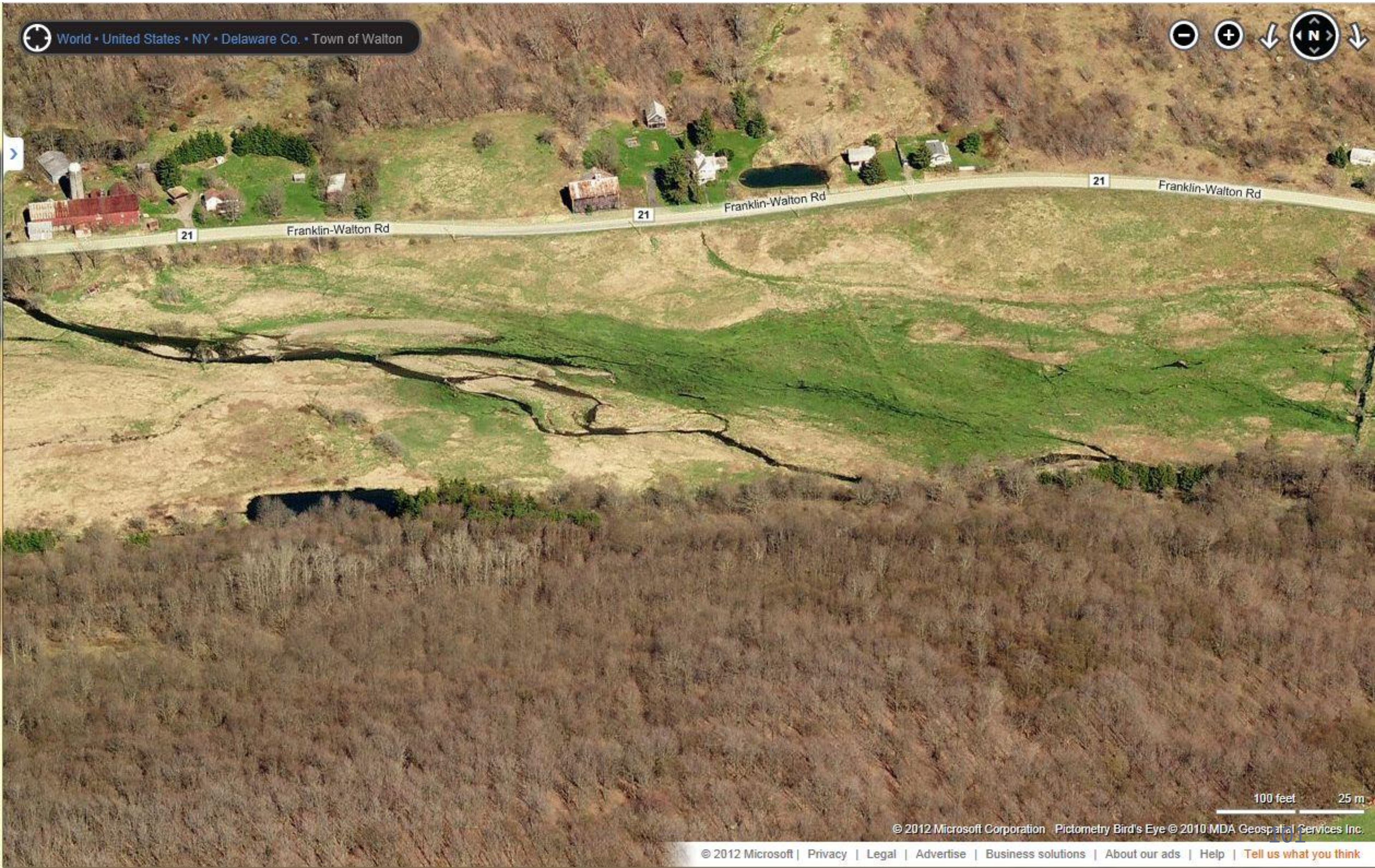
Avulsions

- Do work if property or infrastructure is in danger
- Ask for assistance from local SWCD or NYS DEC office
- If the repair must be made immediately
  - Bring the “new” bank up to the same elevation as the existing ground
  - Armor with large rocks if any are available
  - Notify local SWCD or NYS DEC office of the repair immediately
- *This repair will be temporary and will require careful monitoring*

Platte Kill avulsion 2009

Platte Kill avulsion 2011

West Brook avulsion 2006



West Brook avulsion 2011 - Realignment

Flood Response

Flood Response

- Immediate Priority Items
- High Priority Items
- Assessment
- Repair
- Documentation and Further Needs

Immediate Priority

- *Immediate priority items are those facilities and infrastructure which need to be repaired and/or kept open in order that further recovery may be allowed to continue, or to prevent immediate loss of human life*

Immediate Priority Items

- During or right after a flood some things must be done, including, but not necessarily limited to:
  - Opening clogged bridges
  - Opening closed roads
  - Keeping important installations functioning:

- Power Plants
- Fire Stations
- Rescue Centers
- Hospitals
- Water Wells & Systems
- Sewage Treatment Plants & Systems

Flood Repair

"Emergencies" – obvious problems

- Bridges plugged
- Roads severely damaged/closed
- Buildings (especially inhabited buildings) endangered

High Priority Items

- High priority items are those items that are necessary for the first part of the cleanup process
- This course concentrates on getting channels back into some acceptable condition
  - Open clogged channels
  - Put avulsed channels back in place
  - Stabilize actively eroding streambanks
  - Stabilize (even if only temporarily) landslides
  - *Return the channel to a condition such that the natural processes of streams can begin to return it to its natural state*

Assess the Stream Channels

- To decide where to work and where not to work
- To decide where to work first
- To identify the equipment and work force that will be required
- To identify reaches that require technical assistance

Where to Work – Channel Problems

- Actively eroding high banks
  - Eroding bank is heading toward infrastructure or homes
  - High sediment load from eroding bank
  - Another “small flood” would “blow out” the bank
- Channel blocks
- Debris at culverts
- Undermined revetments
- Impaired channel capacity

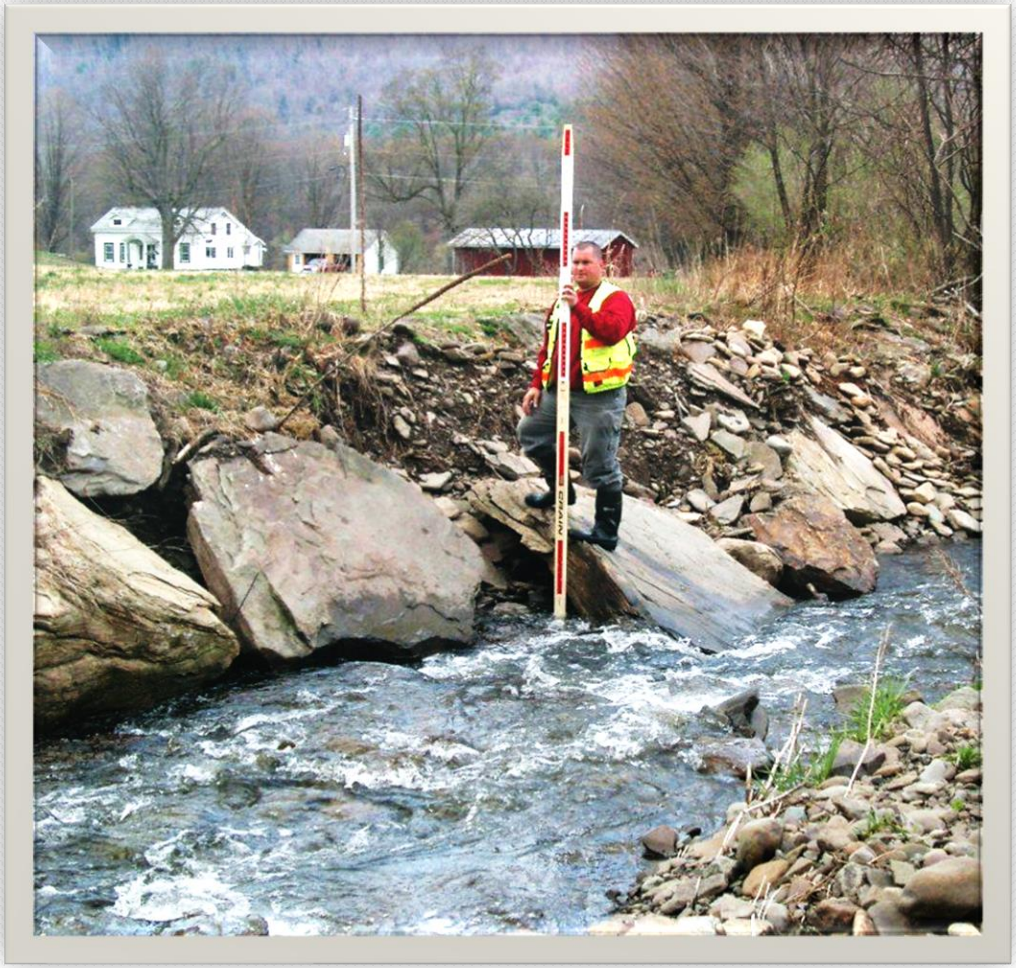
Actively eroding high banks

Channel Block

Debris at a Culverts

Undermined Revetment

- Revetment may become undermined due to:
  - Improper installation depth
  - Stream downcutting



Impaired Channel Capacity

Where Not to Work

- The channel dimensions are ok, or there has been little damage
- Banks are stable
- The channel bottom is imbricated
  - The gravel is “shingled” and is difficult to move
  - Moving the gravel around loosens it and erosion at the reach and deposition downstream

Understanding Imbrication

- As storm flows subside bed material overlap and become wedged together like shingles

- Caused by water velocity

- Materials are less mobile

Understanding Imbrication

Rearranging the bed & banks loosens the material and makes it more transportable

Caution – Steep Streams

- If the slope is over 4% the stream *will* probably be a step-pool system
- If the slope is 2-4% it *could* be a step-pool system
- If debris jam, remove debris
- Don’t try and clean the channel except for gravel material or logs at a debris jam

Would you work here?

- Single channel
- Meanders
- Floodplain

Would you work here?

- Single channel
- Some meander
- Stable banks

Is this what you would do here?

The lack of a floodplain will cause the stream to build one to maintain its natural functions.

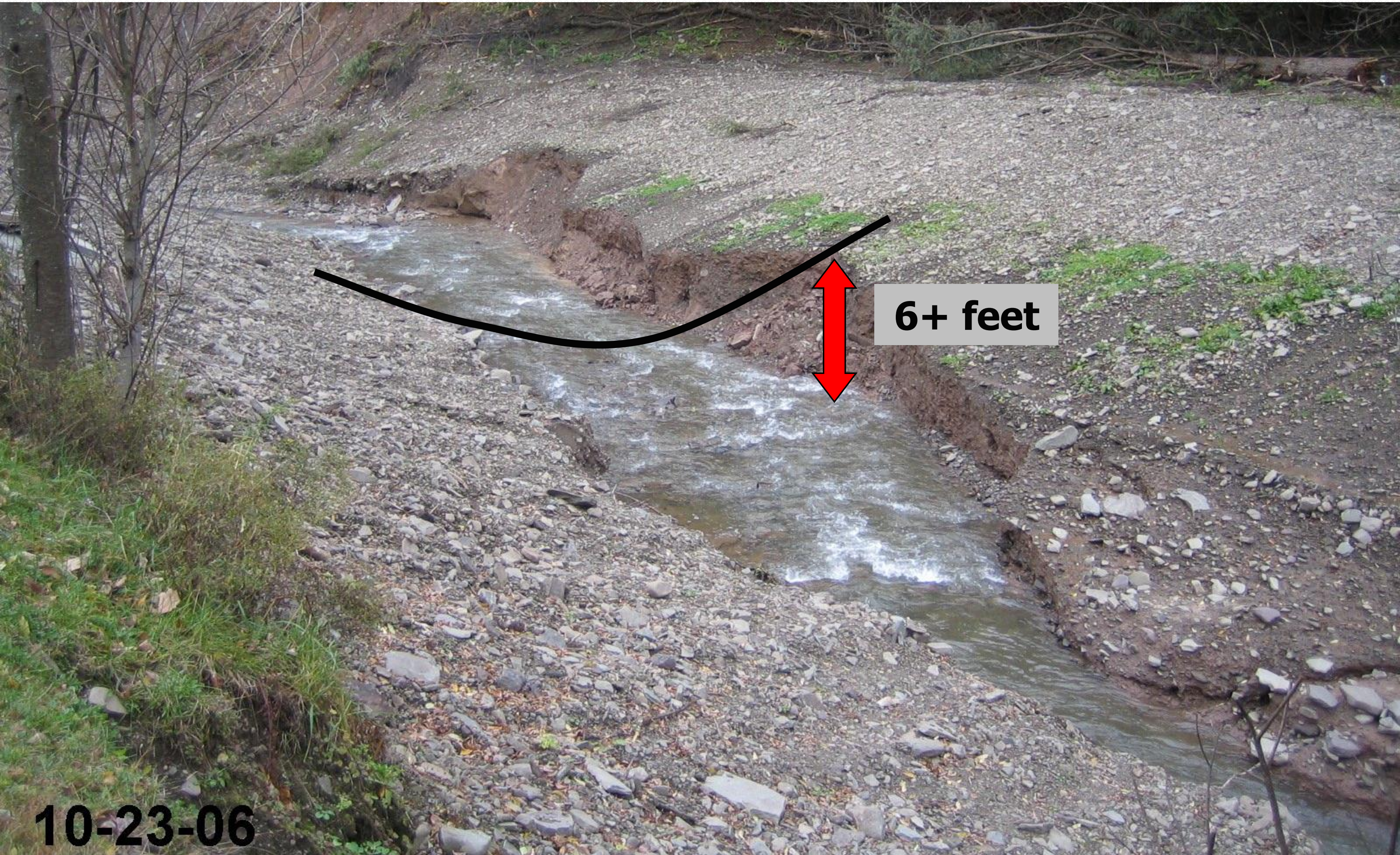

2
Months
10-23-06


4
Months
12-13-06


18
Months
3-06-08

This downstream adjustment created a head-cut upstream…

This slope was actively migrating as the stream continued to lower its bed to adjust its profile. This increased potential risk to those downstream.



Post-Flood Work

- Improper post-flood work can negatively affect:
  - Stream function
  - Stream stability
  - Aquatic habitat
  - Water quality
  - Local resources
- Improper post-flood work can add costs to future repair

Post-Flood Problem Itemization Sheet

- This is located in **Appendix A** in Training Manual
- It lists problems commonly found after a flood
- Use a sheet for each stream reach
- Check off problems; add any notes/sketches that are necessary
- Customize the sheet to suit your needs
- Photos should be taken during the assessment

Post-Flood Problem Itemization Sheet

- The advantages to using the sheet are:
  - Identify the location, number & types of problems on each reach
  - Identify the most severely impacted reaches (keep in mind that some streams or reaches may not be impacted at all)
  - Prioritize work on the most severely impacted reaches
  - Determine manpower & equipment needs
  - Revision of priorities may be required throughout assessment period

Post-Flood Problem Itemization Sheet

- The sheets can serve as a record:
  - That can document work done for state or federal reimbursement
  - This document can be attached to a permit application as additional information
  - To document work done under an emergency permit

Immediate Post Flood Emergency Stream Intervention
Problem Itemization Sheet

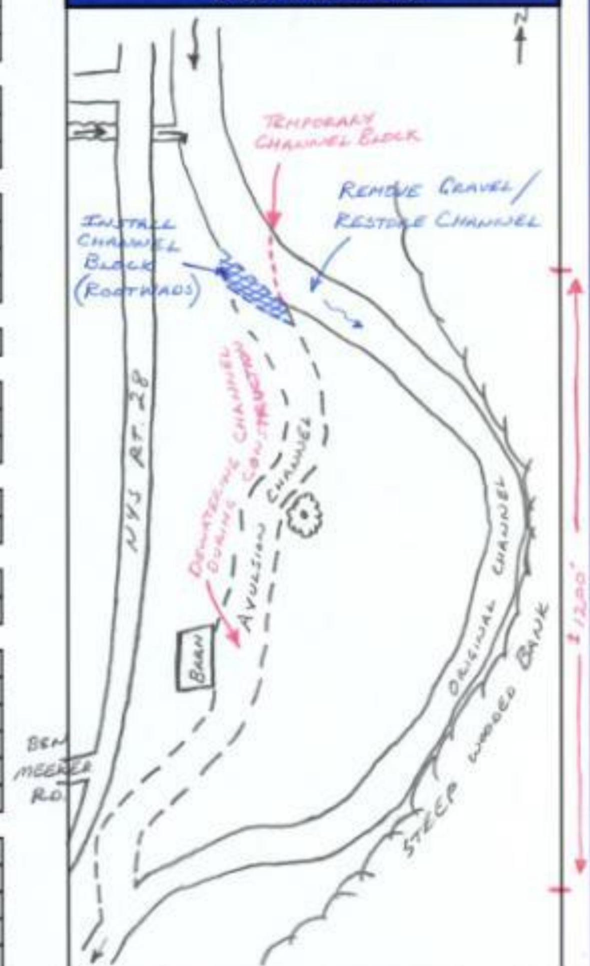
Date: 3/16/09 Time: 2:30 PM

Crew: JOEL + GALE

Stream	PLATTE KILL
Reach	

		YES	NO
Debris Jam at Bridge/Culvert			✓
	Bridge / Culvert		
	Location		
Scour at Bridge/Culvert			✓
	Footings exposed		
	Undermining		
Mass Failure			✓
	Estimated height (avg)		
	Estimated length (avg)		
	Number of failures		
Debris/Log/Gravel Jams		✓	
Avulsion		✓	
	Estimated length	1200'	
	Estimated width	40'	
Scouring/ Down Cutting			
	Estimated depth		
Head Cut			
	Estimated depth		
Gravel Deposits		✓	
	Location - center	✓	
	left side		
	right side		
	Estimated height	3'	
	Estimated length	75'	
Eroded Banks			
	Left bank		
	Right bank		
	Estimated height		
	Estimated length		

Sketch or Comments



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Further Documentation

- Recommended documentation during construction:
  - Before & After photos
  - Description of the work
    - Date
    - Time
    - Equipment
    - Material
    - Labor Force

Further Documentation

- Post Construction Review
  - Was the work performed satisfactorily & completely, and meet the needs identified on the Post-Flood Problem Itemization Sheet?
- Contact local SWCD or NYS DEC offices for assistance with:
  - Vegetation
  - Structures
  - Long Term Monitoring

Channel Sizing

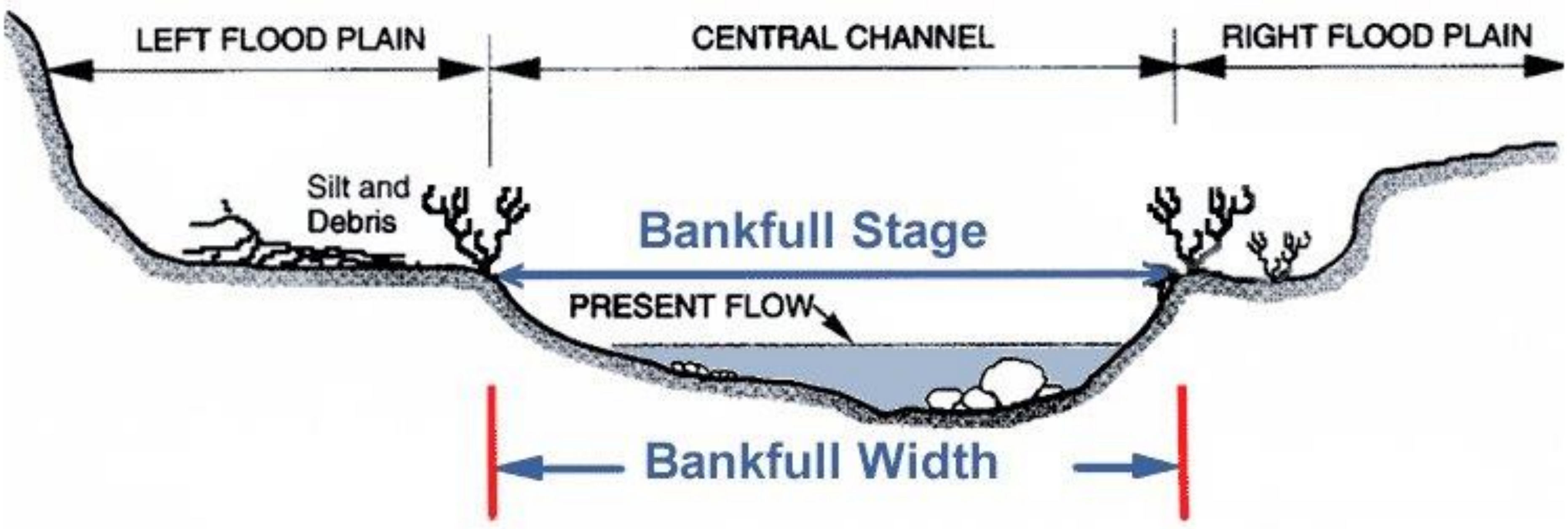
Bankfull Flow

- Bankfull flow is the channel forming discharge

"The bankfull stage corresponds to the discharge at which the channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing the work that results in the average morphologic characteristics of the channel."

Dunne and Leopold, 1978

Bankfull Flow



Adapted from Newbury & Gaboury, 1993

Channel Forming Discharge

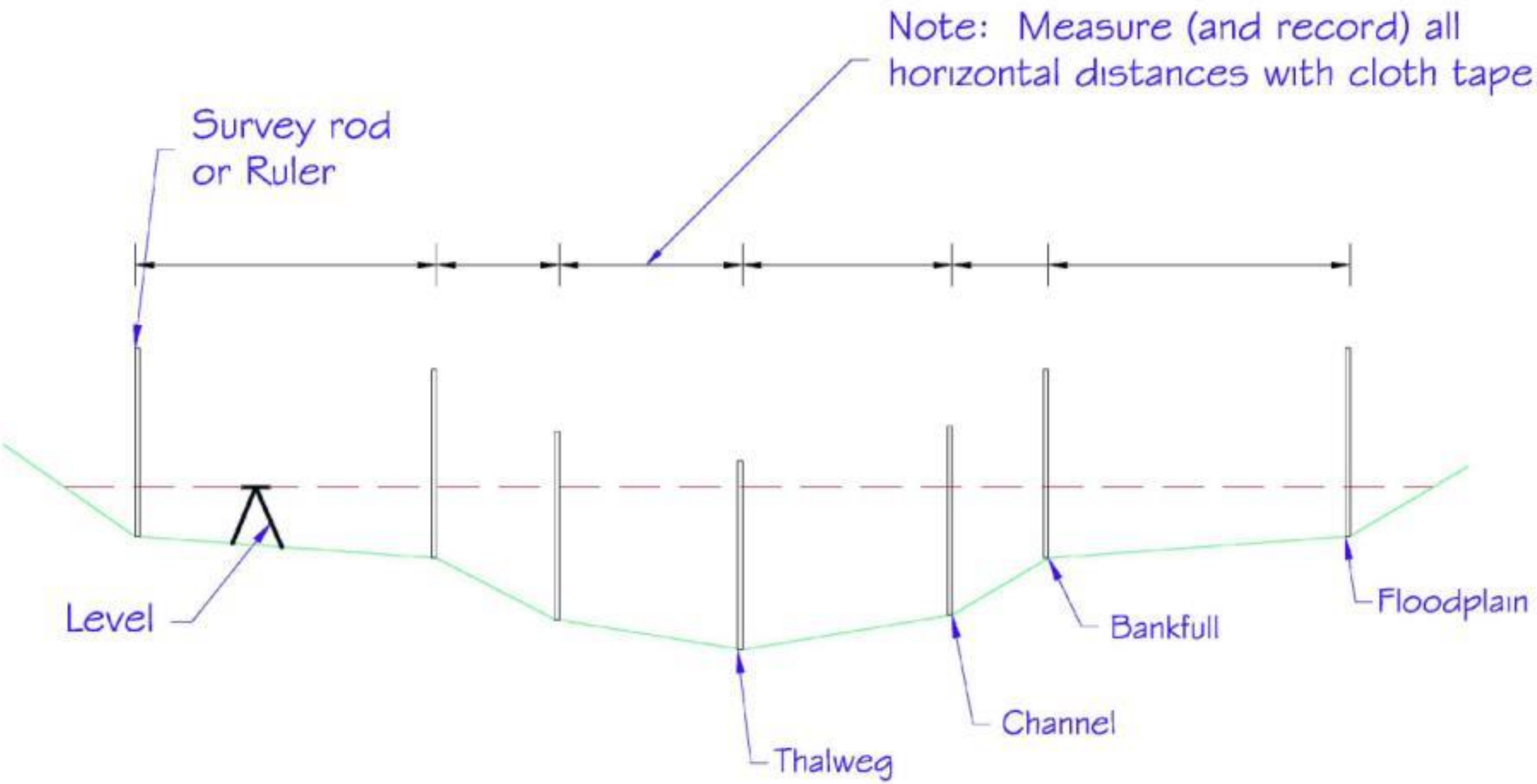
- Channel forming discharge, effective discharge, & bankfull all have the same meaning
- In Delaware County the channel forming discharge is approximately equal to the 1.5 year storm
- The regional curves that give information about the size of the channel are based on the bankfull or channel forming discharge

Using an Existing Stable Reach

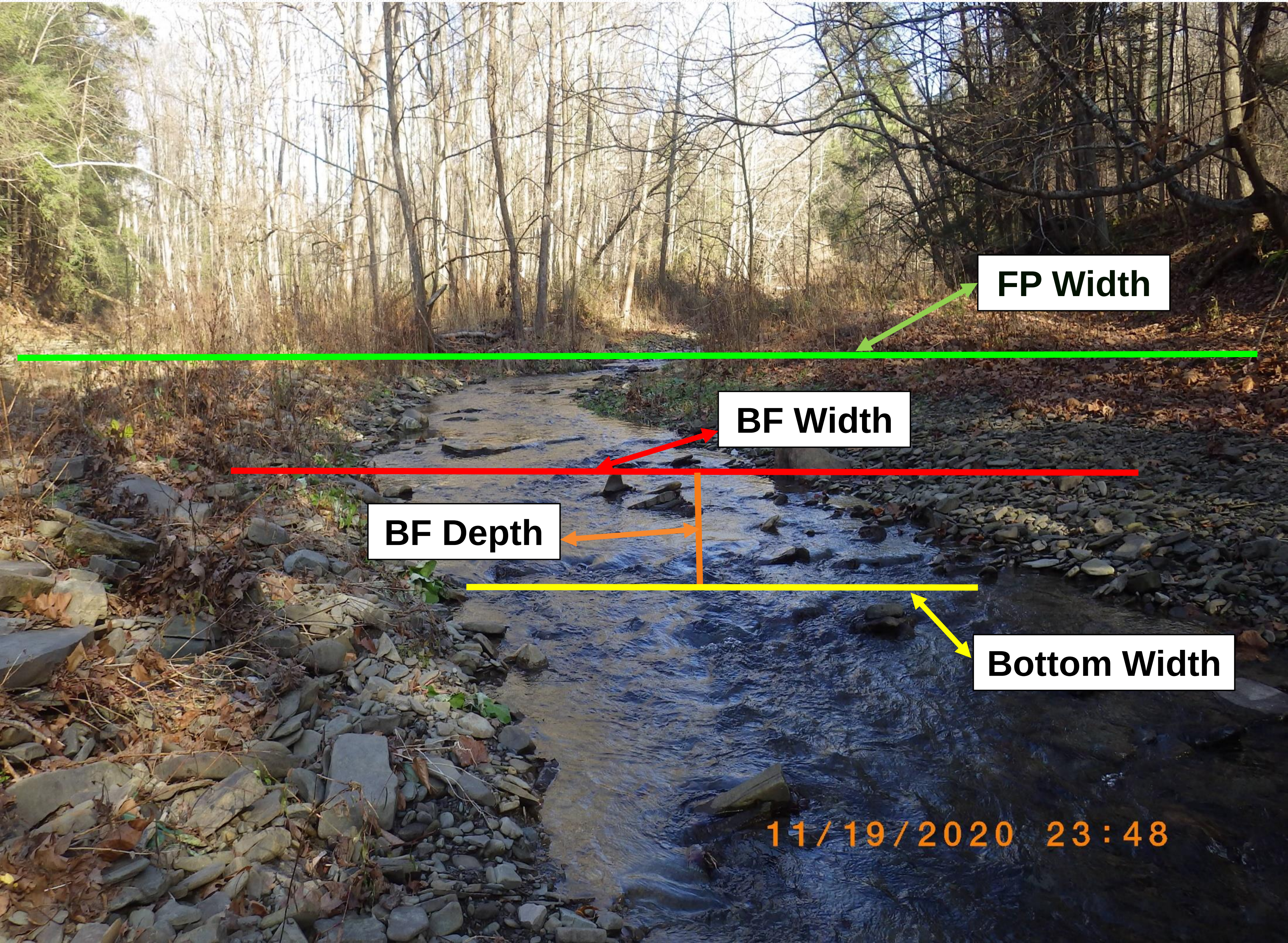
- Use of the tables may not be required
- A relatively undamaged reach may exist either upstream or downstream
- Measure the undamaged reach **AT A RIFFLE** & duplicate it in the damaged reach (draw a sketch)
  - Bankfull width and depth, floodplain width, bottom width, meander curve radius, and stream slope
- Call your local SWCD or NYS DEC office for assistance


10-27-09

Using an Existing Stable Reach



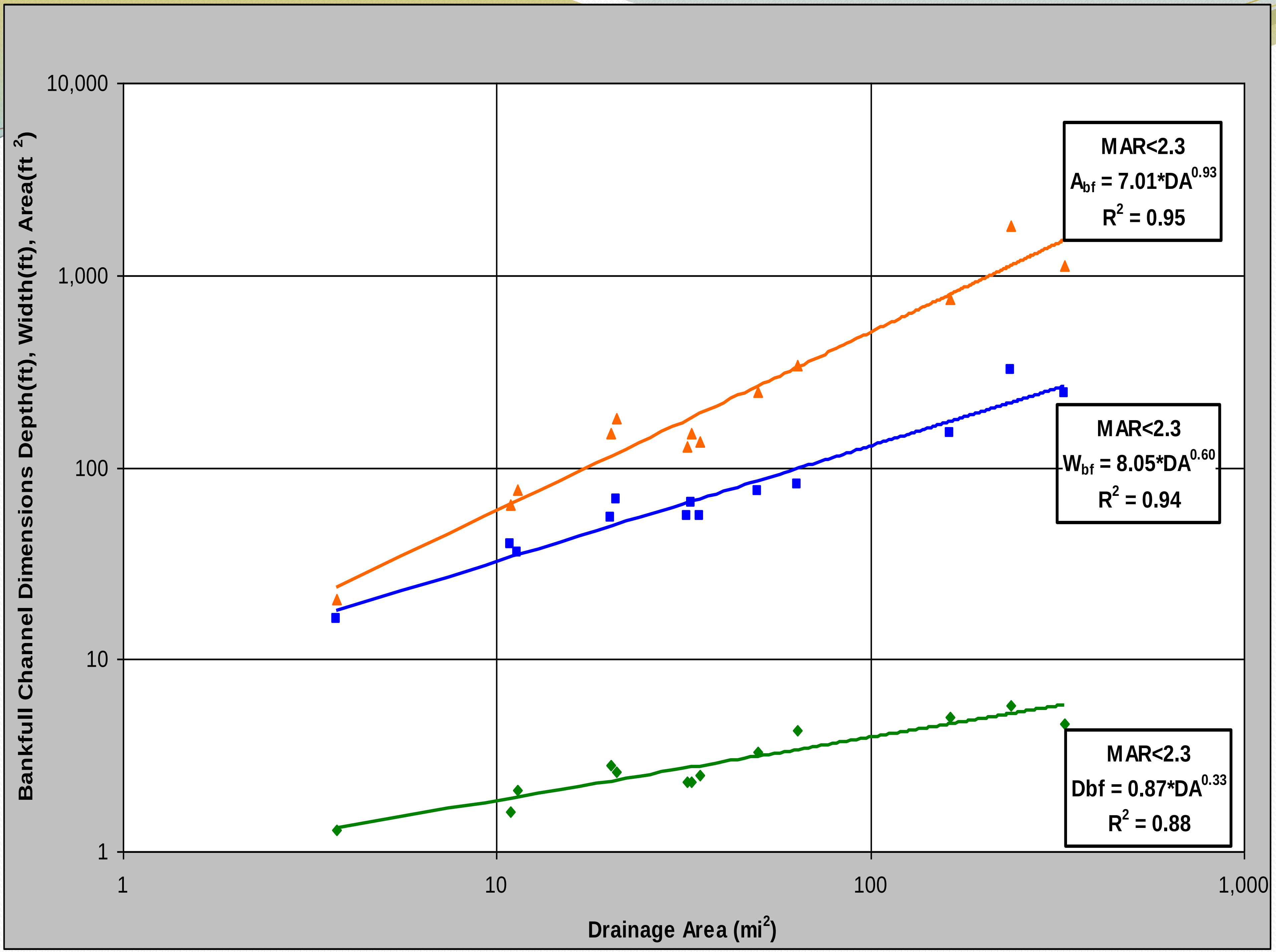
Points to measure on a stable riffle cross section


FP Width
BF Width
BF Depth
Bottom Width
11/19/2020 23:48


Meander radius & slope
11/19/2020 23:47

Regional Curves

- Based on USGS Data
- Information given is based on Drainage Area
- Represents the size & cross section of natural streams in this region
- Dimensions given – Bankfull Dimensions
  - Cross sectional area
  - Bankfull top width
  - Average bankfull depth (mean depth)



10,000
1,000
100
10
1
1
10
100
1,000
Bankfull Channel Dimensions Depth(ft), Width(ft), Area(ft 2)
Drainage Area (mi2)
MAR<2.3
Abf = 7.01*DA0.93
R2 = 0.95
MAR<2.3
Wbf = 8.05*DA0.60
R2 = 0.94
MAR<2.3
Dbf = 0.87*DA0.33
R2 = 0.88

Regional Curves

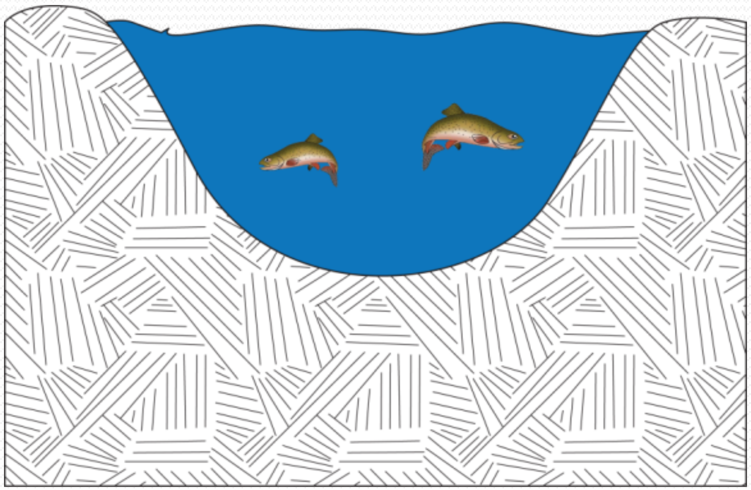
- After a flood the channel dimensions have often been changed – **too big** or **too small**
- Sometimes it is difficult to determine the original size of the stream
- Use the Regional Curves to get reasonable bankfull dimensions

Regional Curves

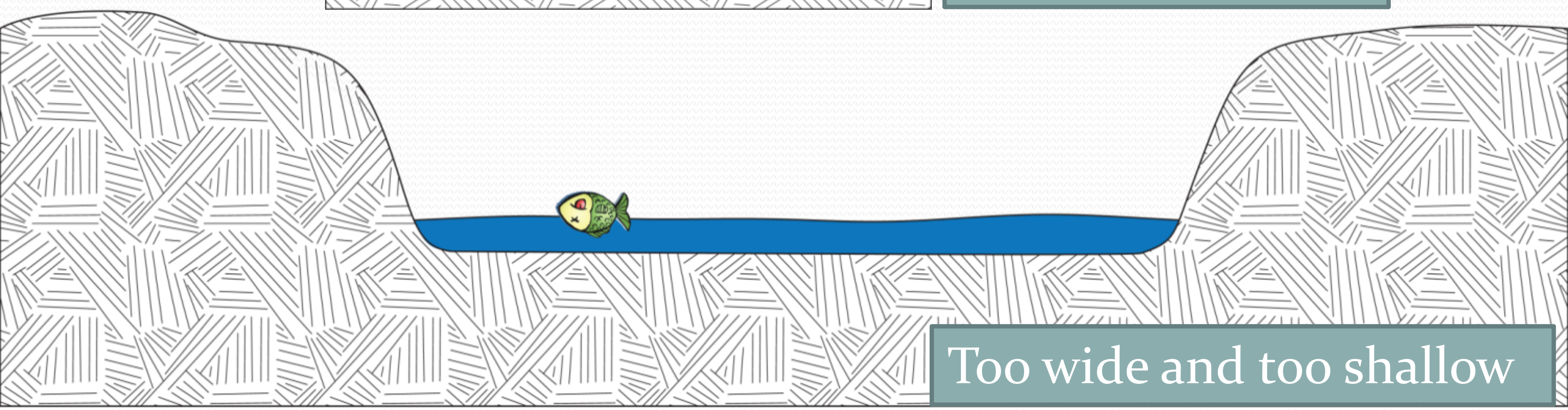
- Proper width and depth are important
- For hydraulics
  - Sized to carry the bankfull flow
  - Moves the proper size and amount of sediment
  - Avoids erosion
  - Avoids deposition
- For the environment

Regional Curves

- Channel dimensions and aquatic habitat



Proper width and proper depth

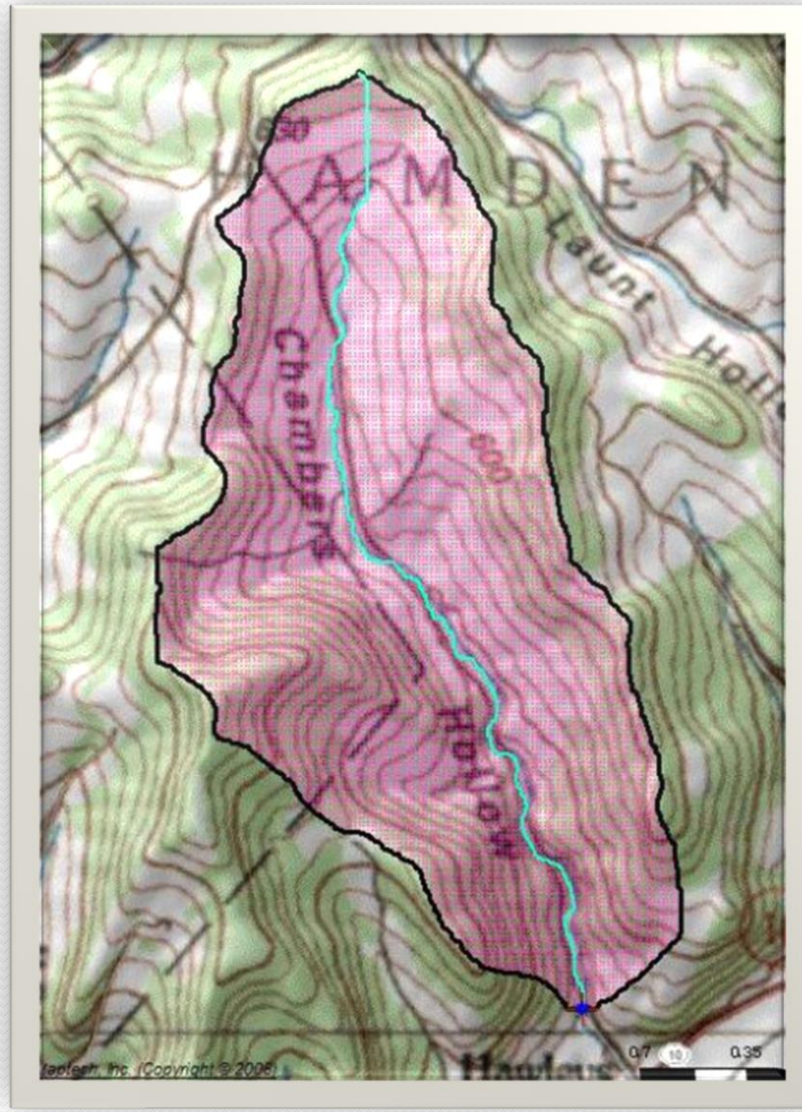


Find Bankfull Channel Dimensions

- Tables have been provided that give the suggested **construction dimensions** in the Training Manual
- You need to know –
  - The drainage area at your site (square miles)
  - What basin you are in

What is a Drainage Area?

The drainage area is the area of the watershed that flows to the point that you are working.



Find Bankfull Channel Dimensions

- Drainage Area can be found:
  - Static maps for New York State are being developed
  - Streamstats New York:

    https://streamstats.usgs.gov/ss/
  - Instructions for use are on the left side of the webpage. Click on State Applications to access New York
    - See **Appendix D** for the version that is up and running now
  - Streamstats New York will provide regional curve data that can be used with the tables provided to generate construction dimensions

Classroom Examples

Classroom Example #1 (page 24)

- Flooding has occurred in Woodhull, NY in the south Branch of Tuscarora Creek and repair work is needed on a small stretch of stream. There is a bridge ¼ mile downstream of the affected area with a drainage area of 19.6 square miles.

- Find the following:
  - Bankfull width
  - Bankfull depth
  - Bankfull area
  - Floodplain width

1. Find the Drainage Area (D.A.)

- Drainage area at the bridge is 19.6 square miles
  - Use the appropriate Regional Bank-full Hydraulic Geometry Table from Appendix C
  - Use 20.0 square miles

2. Select the Proper Table (Appendix C)

- There is a table for each of the Hydrologic Regions in New York State

- Woodhull is located in the Southern Tier Region

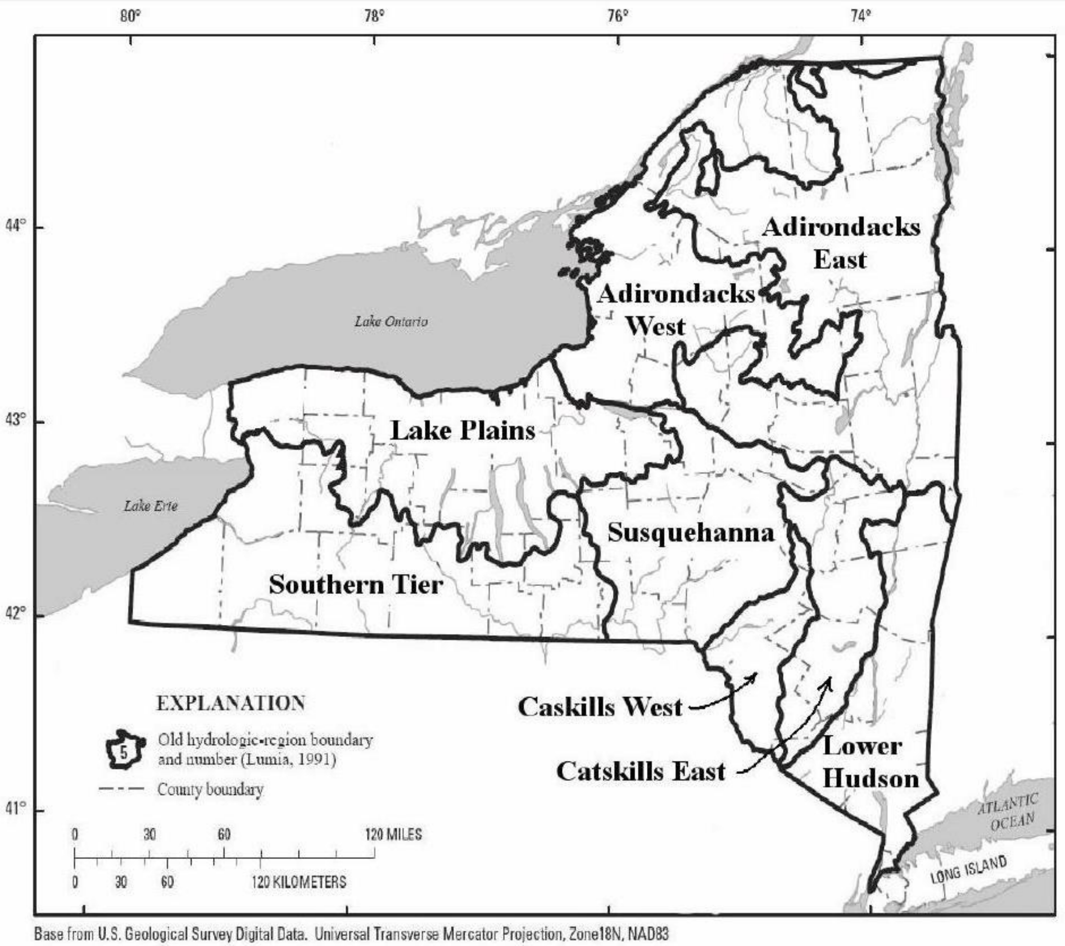


Figure 3.7 Hydrologic Regions in New York State

3. Find the Construction Dimensions

- Enter the table at the correct D.A. in the left hand column
- Read across & note the construction dimensions

Southern Tier Region

Bank Full Hydraulic Geometry vs. Drainage Area for Selected Hydrologic Regions

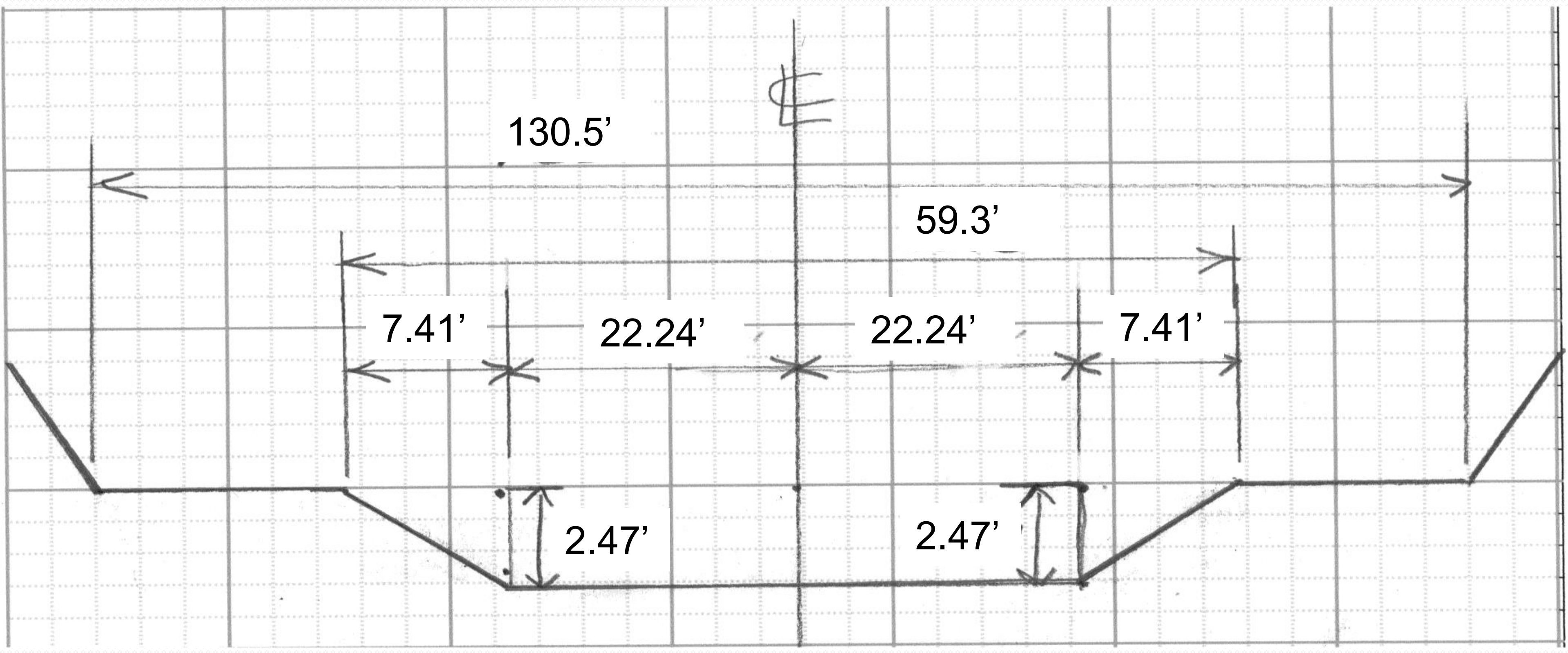
				Construction Dimensions					
DA (sq. mile)	Bank-Full Area (sq. ft)	Bank-Full Width (ft)	Bank-Full Depth (ft)	channel side slope	D (ft)	3D (ft)	X (ft)	TW (ft)	Min. FP (ft)
1.0	17.60	16.90	1.04	3:1	1.38	4.13	4.32	16.90	37.18
2.5	32.28	24.81	1.30	3:1	1.62	4.85	7.56	24.81	54.58
5.0	51.08	33.17	1.54	3:1	1.85	5.55	11.04	33.17	72.98
7.5	66.80	39.31	1.70	3:1	2.01	6.02	13.63	39.31	86.49
10.0	80.82	44.35	1.82	3:1	2.13	6.39	15.78	44.35	97.57
12.5	93.68	48.70	1.93	3:1	2.23	6.70	17.65	48.70	107.13
15.0	105.70	52.56	2.01	3:1	2.32	6.96	19.32	52.56	115.64
17.5	117.06	56.07	2.09	3:1	2.40	7.20	20.84	56.07	123.35
20.0	127.88	59.30	2.16	3:1	2.47	7.41	22.24	59.30	130.45

Answer to Example #1

- Bankfull width = 59.30 ft.
- Bankfull depth = 2.16 ft.
- Bankfull area = 127.88 $ft.^2$
- Floodplain width (FP) = 130.45 ft.

Classroom Example #1

- It is highly recommended that you prepare a sketch of the proposed cross section to use during stake out & construction

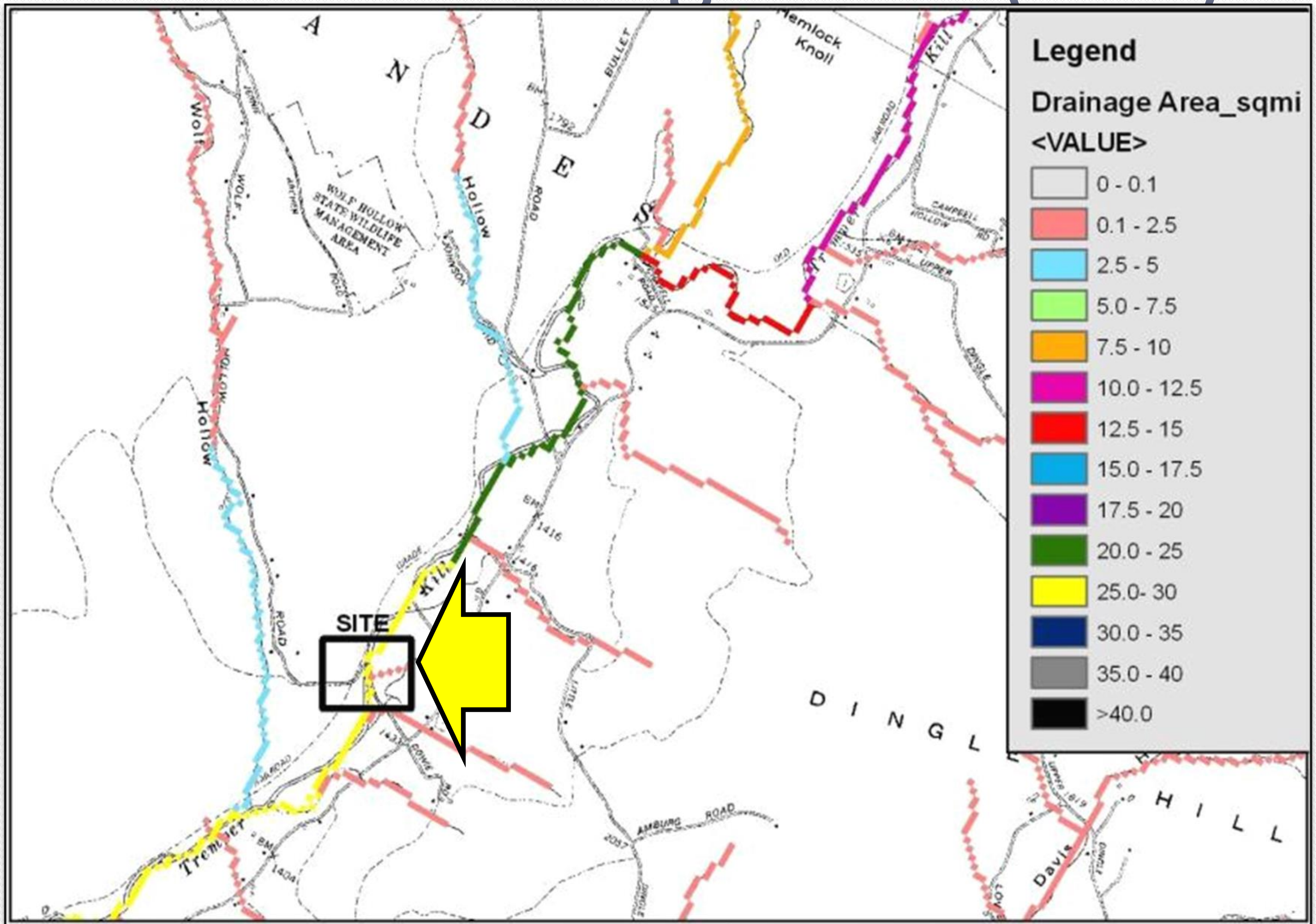


Classroom Example #2 (page 25)

- Flooding has occurred in Andes, NY on a portion of the Tremper Kill stream near Wolf Hollow Road.

- Find the following:
  - Drainage Area
  - Construction Dimensions

1. Find the Drainage Area (D.A.)



1. Find the Drainage Area (D.A.) Cont.

- On the map, the reach is coded **YELLOW**
- The key tells us that this is between 25-30 square miles
- Wolf Hollow road intersection is near the upper end of the reach – use 25 square miles

2. Select the Proper Table (Appendix C)

- There is a table for each of the Hydrologic Regions in New York State

- Andes is located in the Catskill West Region

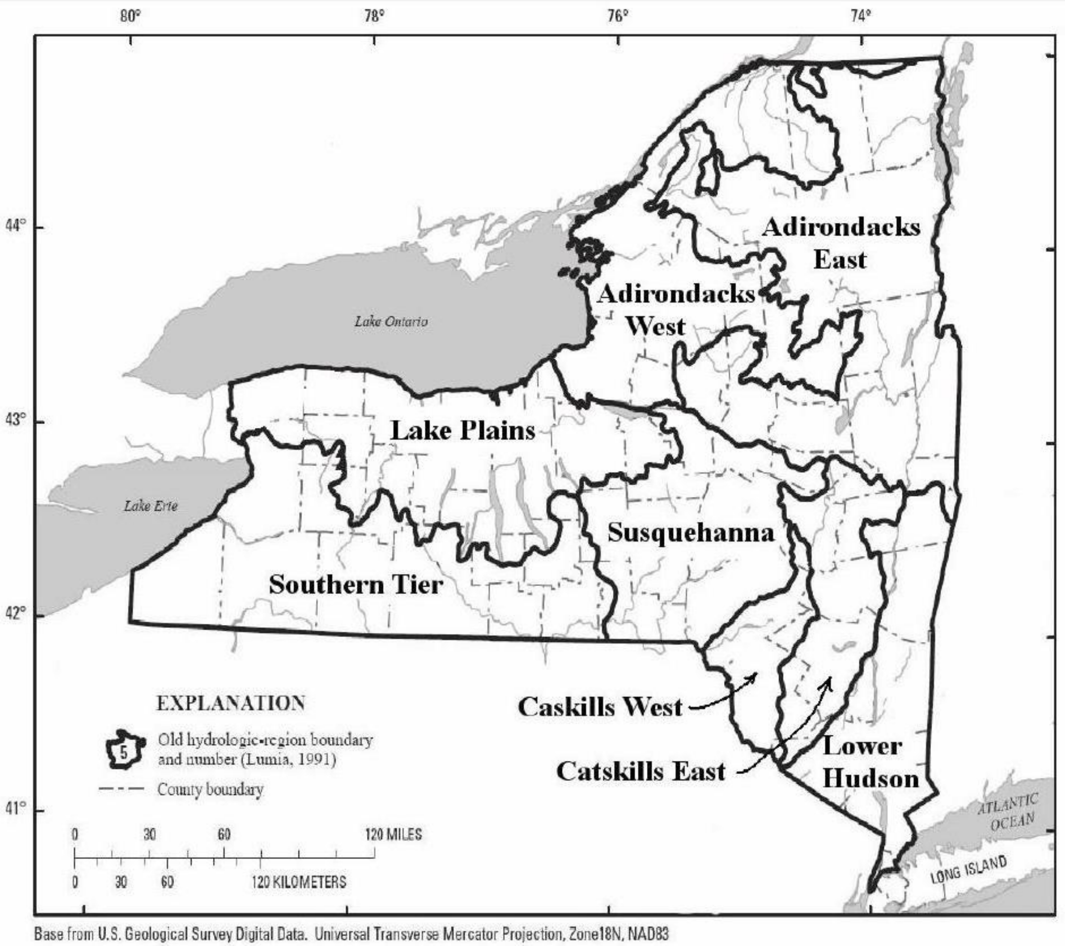


Figure 3.7 Hydrologic Regions in New York State

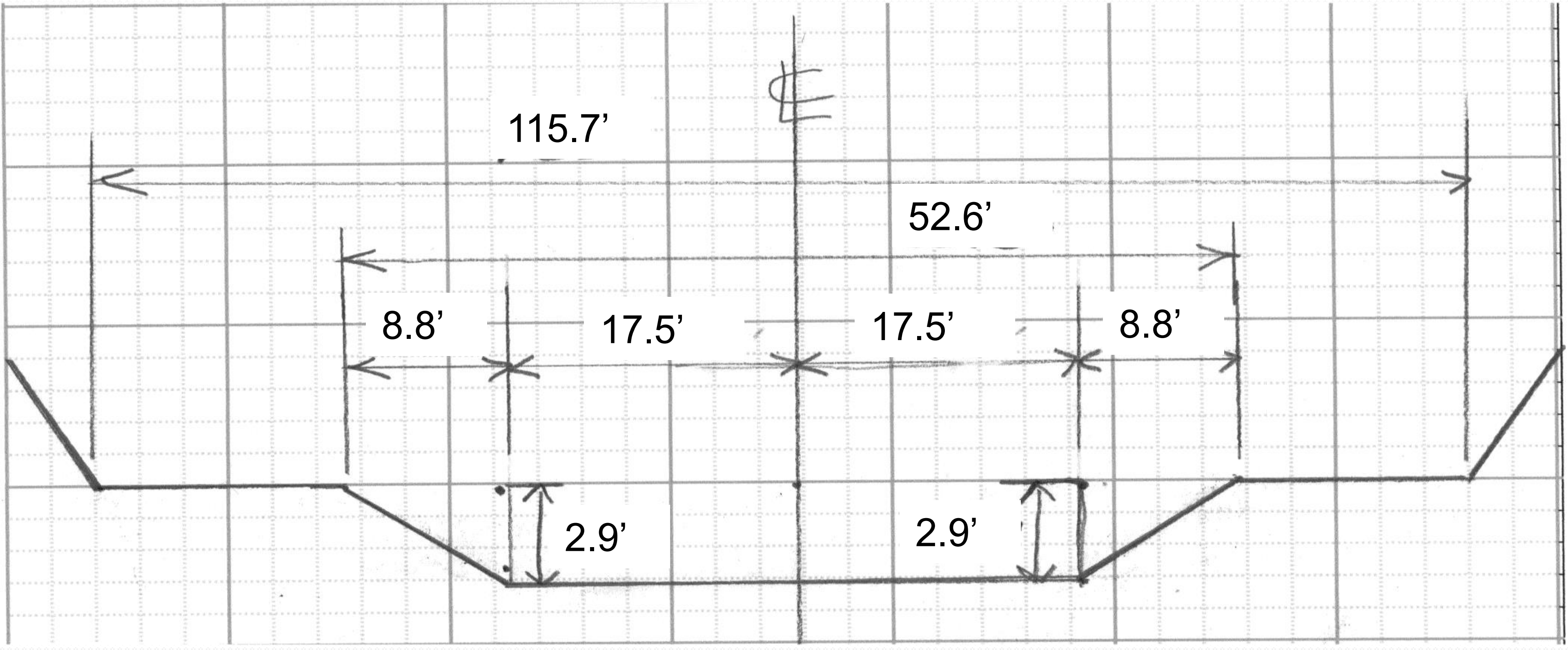
3. Find the Construction Dimensions

- Enter the table at the correct D.A. in the left hand column
- Read across & note the construction dimensions

DA (sq. mile)	Bankfull Area (sq. ft)	Bankfull Width (ft)	Bankfull Depth (ft)	Construction Dimensions: channel bank side slope	D (ft)	3D (ft)	X (ft)	TW (ft)	Min. FP (ft)
1	7.2	9.1	0.8	2:1	1.0	2.1	2.5	9.1	20.0
2.5	16.3	15.0	1.1	3:1	1.6	4.8	2.7	15.0	33.0
5	30.4	21.9	1.4	3:1	1.9	5.6	5.3	21.9	48.1
7.5	43.6	27.3	1.6	3:1	2.1	6.2	7.4	27.3	60.0
10	56.4	31.9	1.8	3:1	2.2	6.7	9.2	31.9	70.2
12.5	68.9	36.0	1.9	3:1	2.4	7.2	10.9	36.0	79.3
15	81.1	39.8	2.0	3:1	2.5	7.5	12.4	39.8	87.6
17.5	93.0	43.3	2.2	3:1	2.6	7.9	13.8	43.3	95.3
e20	104.8	46.6	2.3	3:1	2.7	8.2	15.1	46.6	102.5
22.5	116.5	49.7	2.3	3:1	2.8	8.5	16.3	49.7	109.2
25	128.0	52.6	2.4	3:1	2.9	8.8	17.5	52.6	115.7
27.5	139.3	55.4	2.5	3:1	3.0	9.0	18.7	55.4	121.9
30	150.6	58.1	2.6	3:1	3.1	9.3	19.8	58.1	127.8

Classroom Example #2

- It is highly recommended that you prepare a sketch of the proposed cross section to use during stake out & construction



Work Methods

Limiting Gravel Removal

- Do **<u>NOT</u>** remove gravel to such a depth that the channel is disconnected from the floodplain
- Do **<u>NOT</u>** remove point bars
  - Removing them may increase deposition & destabilize the system
  - If you think a point bar has grown too large ask for advice from local SWCD or NYS DEC

Limiting Gravel Removal

- Generally, center bars & side bars can be safely removed
- Do **NOT** over excavate or over-widen
- If the center bars & side bars are **NOT** a product of the flood leave them alone. You have more important things to do
- Remove all excess materials from the floodplain – DO NOT SIDE CAST ON BANKS

Reconnecting to the Floodplain

- The provided tables give you the dimension for the floodplain
- The elevation of the floodplain is at the bankfull elevation
- The channel is automatically reconnected to the floodplain
- If there is not enough room available for the recommended width, make the floodplain as wide as you can

Due to the lack of room, there is floodplain on one side of the channel only


3-30-09


07-29-09

2011 Hurricane Irene

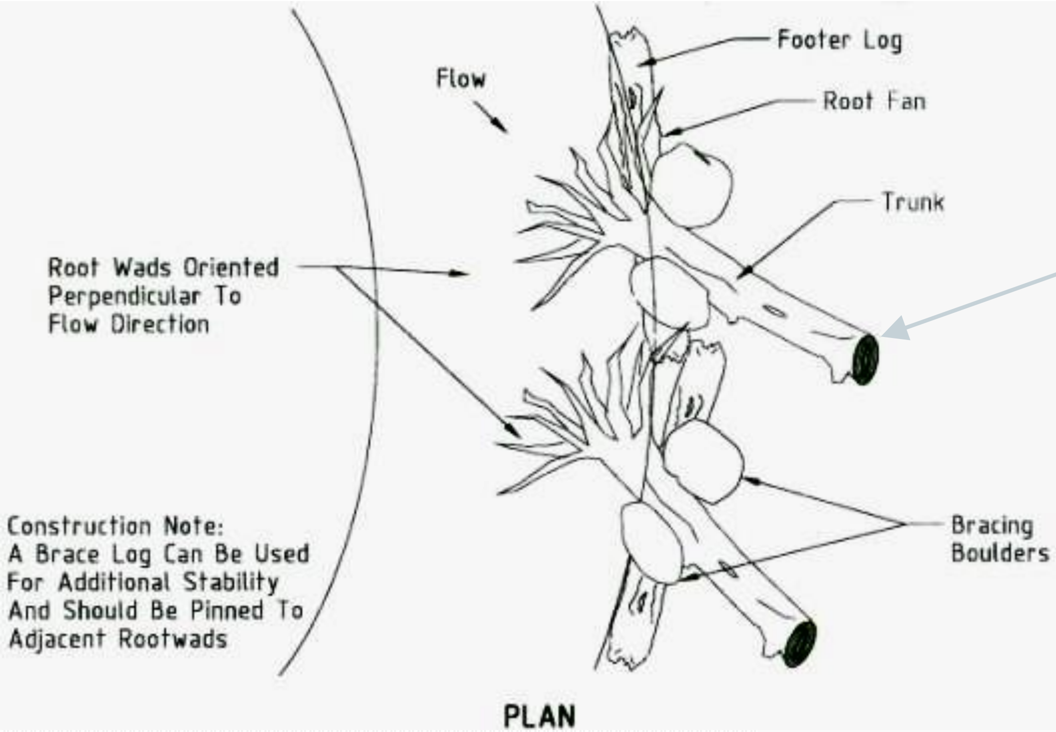
Impact on Dry Brook Stream in Arkville, NY

© 2011 Google
Google earth
199
42°09'06.75" N 74°37'36.01" W elev 1321 ft
Eye alt 3673 ft

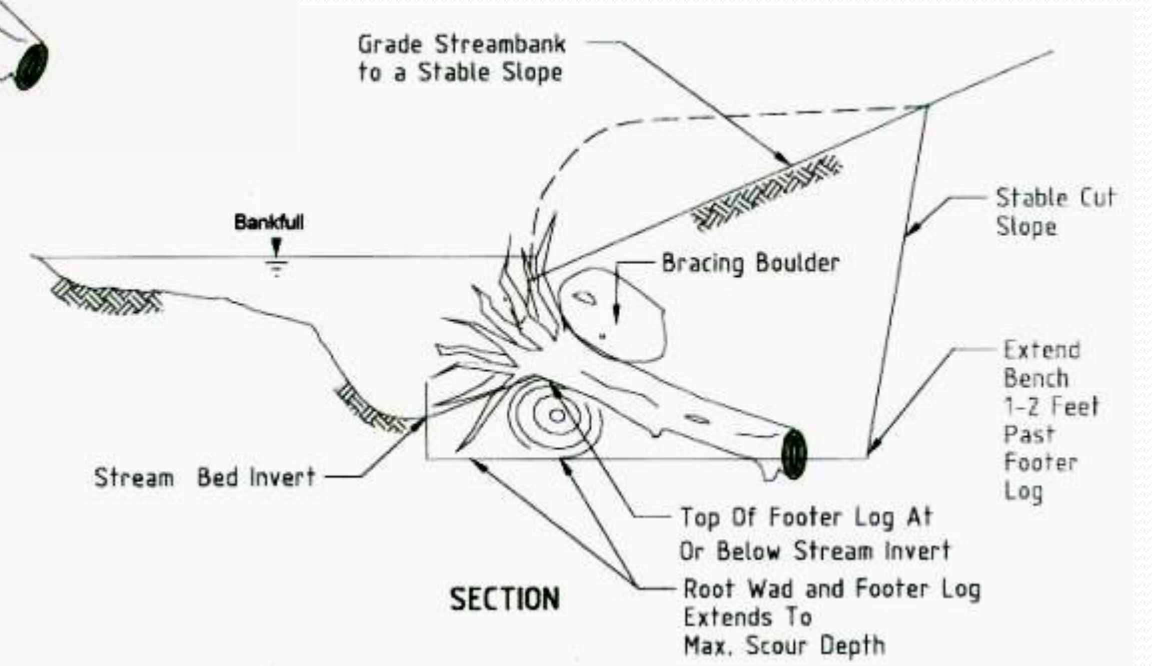
Root Wads

- Root wads can be used to stabilize the streambank
- Use debris trees that are conveniently located nearby
- The bottom of the root ball should be below the channel grade
- Brace with boulders or other large logs

Root Wads



Leave trunk as long as possible



Root wads were placed in two layers with large rocks to hold them in place.


Link-Belt
9-22-2011

Vegetation

- Vegetation holds the streambanks together
- For emergency work, there is no time to plant trees and shrubs
- Grass will provide short term stability and prevent fine sediment runoff
- Seed and mulch or hydroseed (this will be a NYS DEC permit condition)

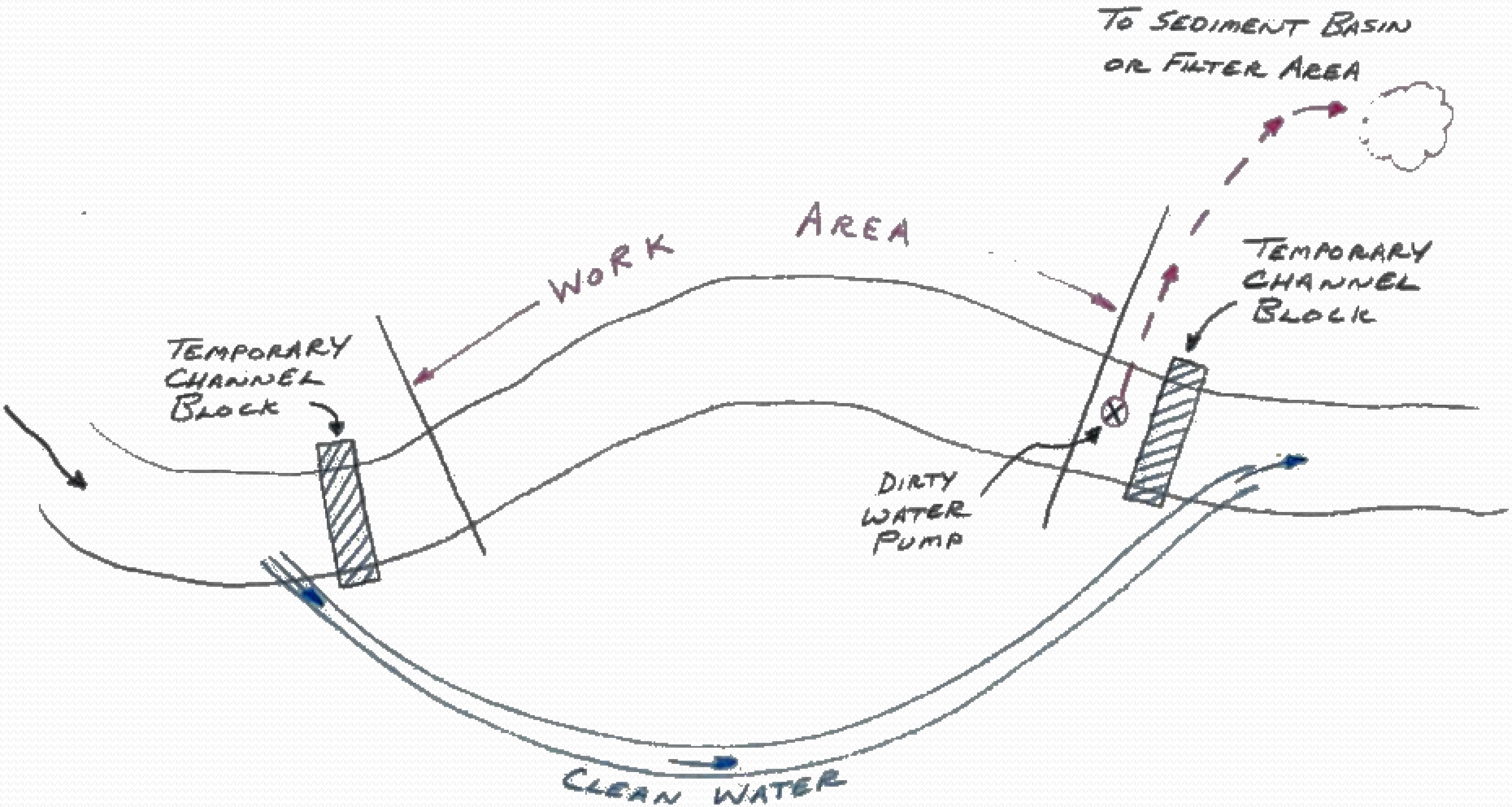
Vegetation

- After repair if there is an absence of woody vegetation on the banks inform local SWCD, NYS DEC, and the local municipality
- A proper vegetation plan can be designed & implemented later

De-watering

Must isolate the work area

General Work Area Schematic



De-watering – Avulsion

De-watering – Avulsion

De-watering – Point Bar

Diversion – General Rules

- Place the barrier as close to the work area as possible without interfering with the operations
  - This maximizes area open to flow
- Plan the staging of your barrier – minimize the number of times the barrier will have to be moved
- The ends of the barrier will have to tied in to the bank or placed high enough so that they cannot be outflanked by the water

Diversion – Barrier


Blocks wrapped in plastic
8-03-07

Pumping Around

Take advantage of your site

Pumping Around

- Generally only done on small streams
  - Dave Post farm (DA = 3 mi^2)
    - Planned on pumping 5 cfs
    - Actually pumped 15 cfs
- May be done on short term projects during known periods of low flow
  - Combination of bypass and pumping

Pump Capacities

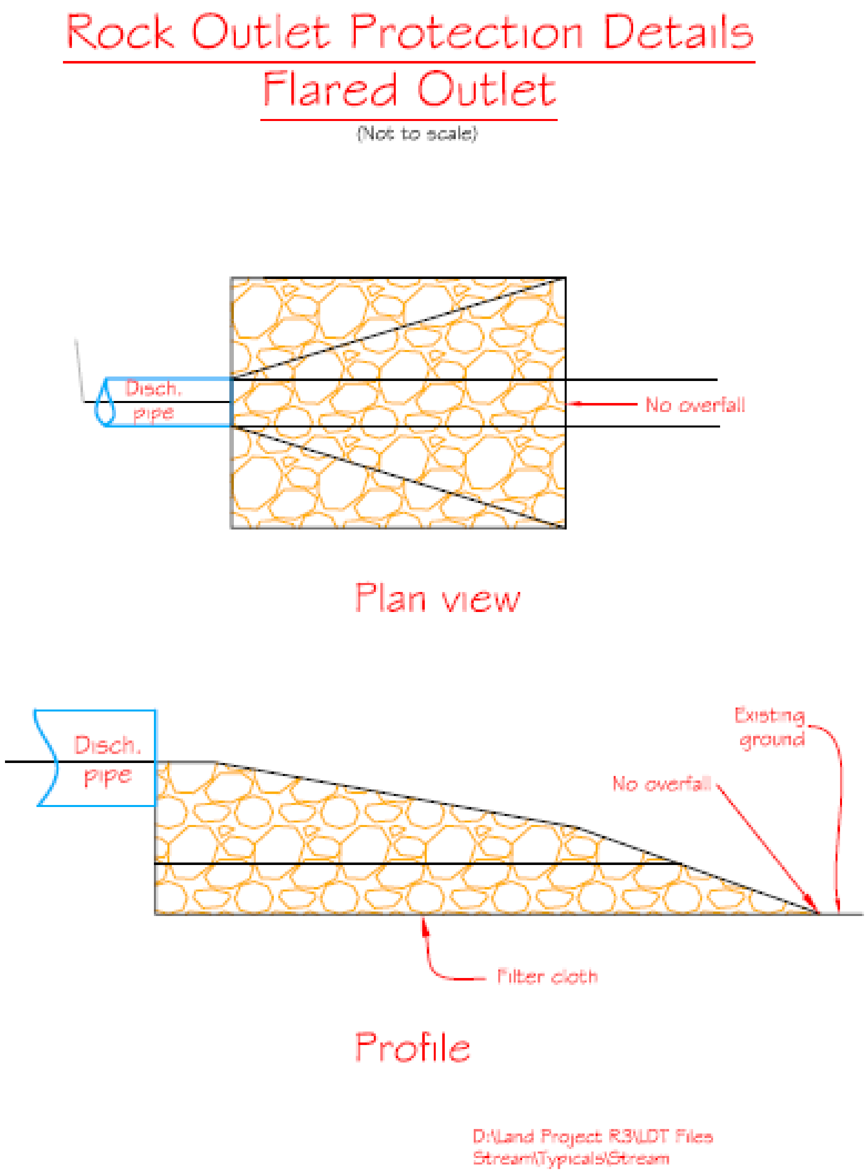
Pump Size	Max Capacity CFS	Max Capacity GPM
2"	0.5	216
3"	0.7	300
4"	1.6	700
6"	4.5	2000
8"	7	3200
10"	7.8	3500
12"	10	4500

Source: Godwin Pump, CD Series Dri-Prime

Pumping Around

- Place the pipe outlet at a well vegetated area
- Construct the energy dissipater
- Check frequently to be sure that the device is working and that no erosion is occurring
- Clean water in sheet flow enters the stream – *only!*

Pump Outlet Protection



- Leave rock loose and "jumbled"
- Adjust elevation of pipe if necessary
- Add rock and cloth if necessary
- *Intent is to induce sheet flow and avoid erosion*


08-12-10

Diversion or Pumping Around

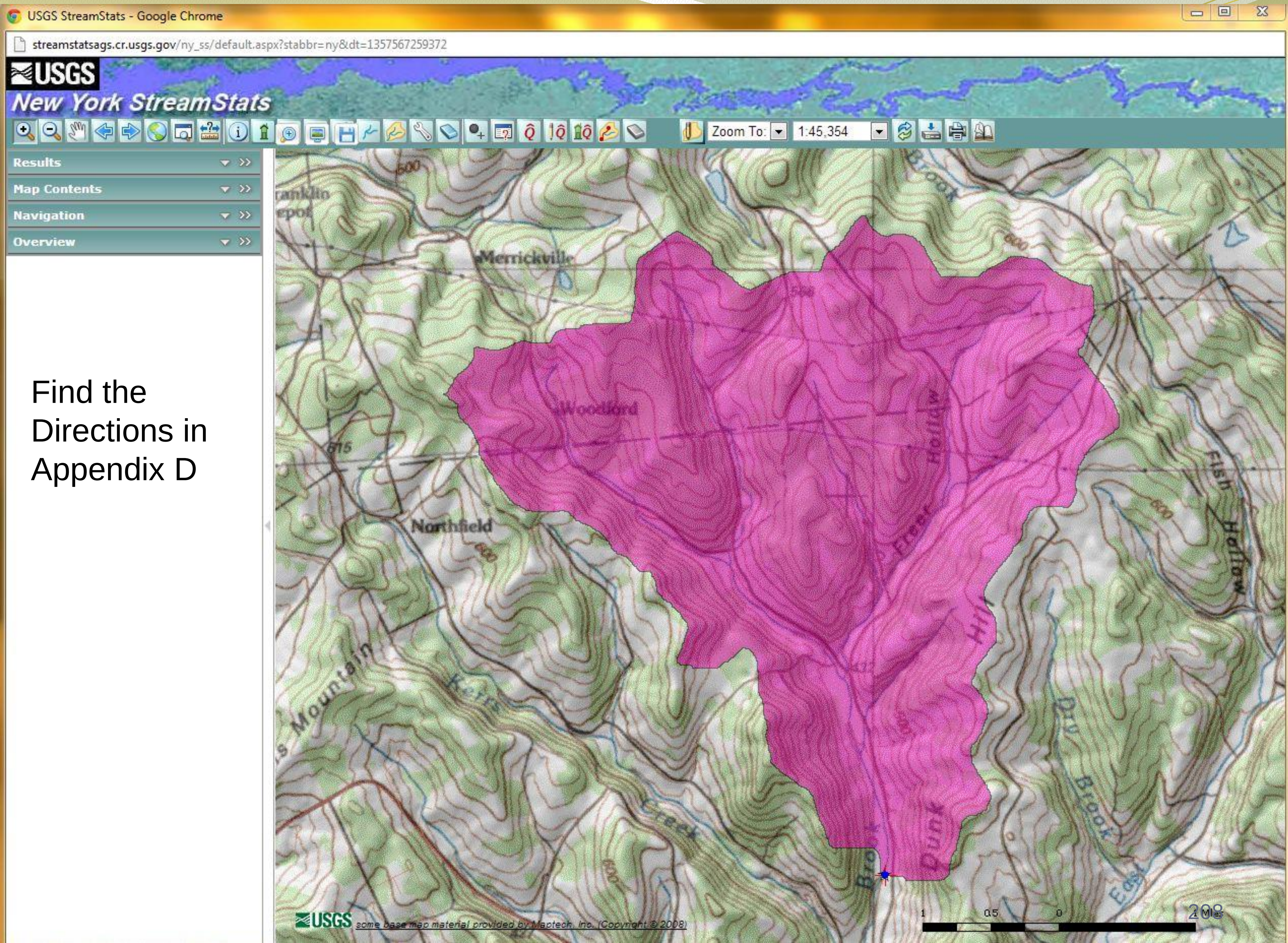
- No turbid water may leave the site
- Cause no erosion
- Check your operation often!
- If have any problems, **stop and repair at once!**

Project Sites

West Brook – Before


4-11-08


4-11-08



Find the Directions in Appendix D

Basin Characteristics Report - Google Chrome

streamstatsags.cr.usgs.gov/gisimg/Reports/BasinCharsReport119183_20131771416.htm

USGS

New York StreamStats

Print

Basin Characteristics Report

Date: Mon Jan 7 2013 07:14:16 Mountain Standard Time
NAD27 Latitude: 42.2099 (42 12 36)
NAD27 Longitude: -75.1194 (-75 07 10)
NAD83 Latitude: 42.2100 (42 12 36)
NAD83 Longitude: -75.1190 (-75 07 08)
ReachCode: 02040101000148
Measure: NaN

Parameter	Value
Area that drains to a point on a stream in square miles.	12.6
Main-channel 10-85 slope, in feet per mile	89.1
Main-channel stream length, in miles	5.92
10-85 slope of lower half of main channel in feet per mile.	57.3
10-85 slope of upper half of main channel in feet per mile.	134
Total length of all elevation contours in drainage area in miles	107.95477950
Average basin slope, in feet per mile.	856
Slope ratio. Ratio of main channel slope to basin slope	0.1
Basin Lag factor.	0.0667
Percentage of basin at or above 1200 ft elevation	100
Basin storage. Percentage of total drainage area shown as lakes, ponds and swamps	0.25
Percent of area covered by forest	74.4
Mean annual runoff in inches.	24.2
Seasonal maximum snow depth, 50th percentile, in inches	15.2
Mean annual precipitation in inches.	44
Urban Land Use percentage (1992)	0.0132

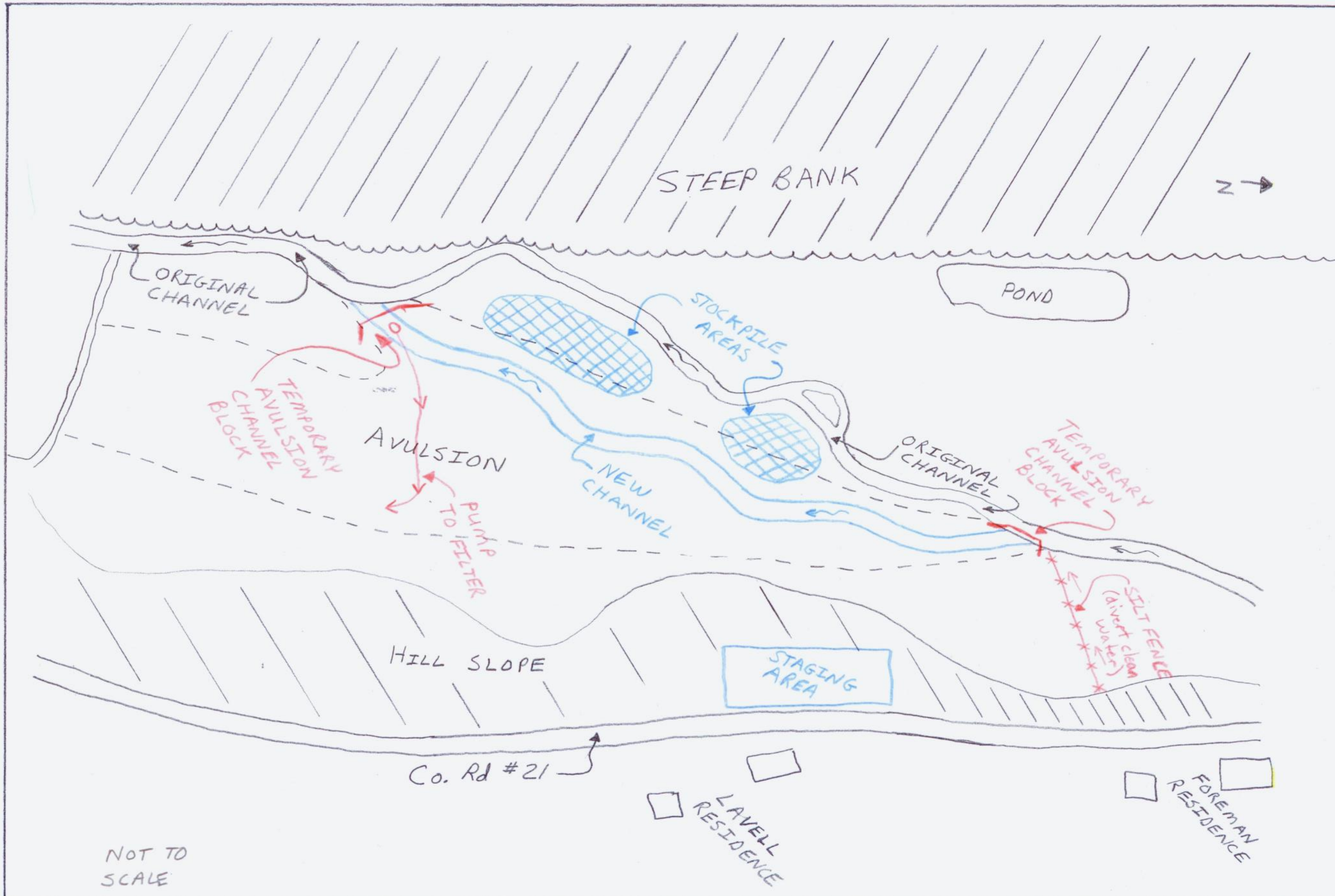
Peak Flows Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_25	389	29	3.1		
PK1_5	475	29	2.6		
PK2	586	28	2.5		
PK5	887	25	4.2		
PK10	1100	23	6.5		
PK25	1390	22	9.9		
PK50	1620	22	13		
PK100	1850	22	15		
PK200	2090	22	17		
PK500	2410	22	19		

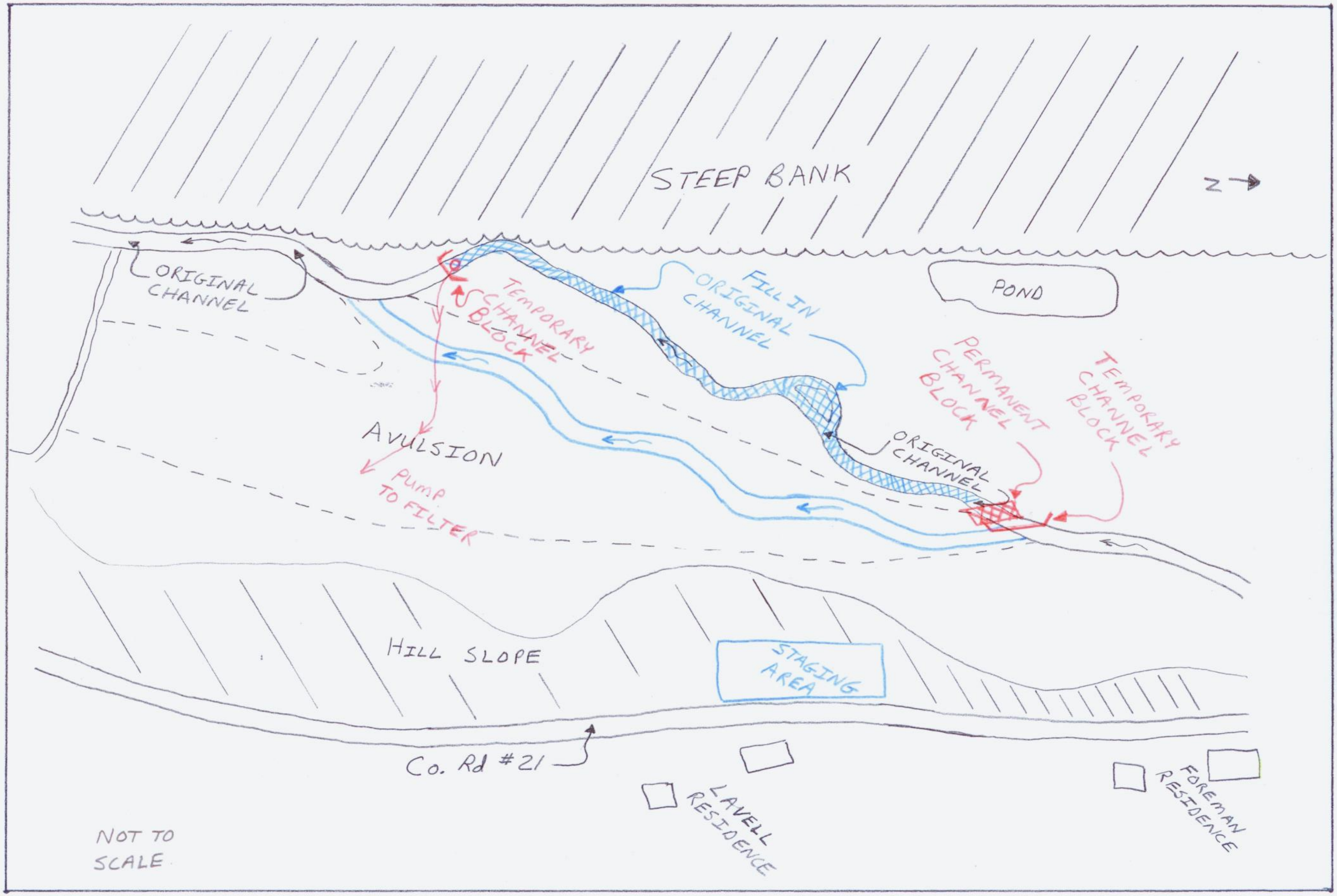
Bank Full Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	86.9	24		47.9	157
BFDPTH	2.11	20		1.21	3.69
BFFLOW	396	36		119	1320
BFWDTH	42.1	27		22.5	78.9

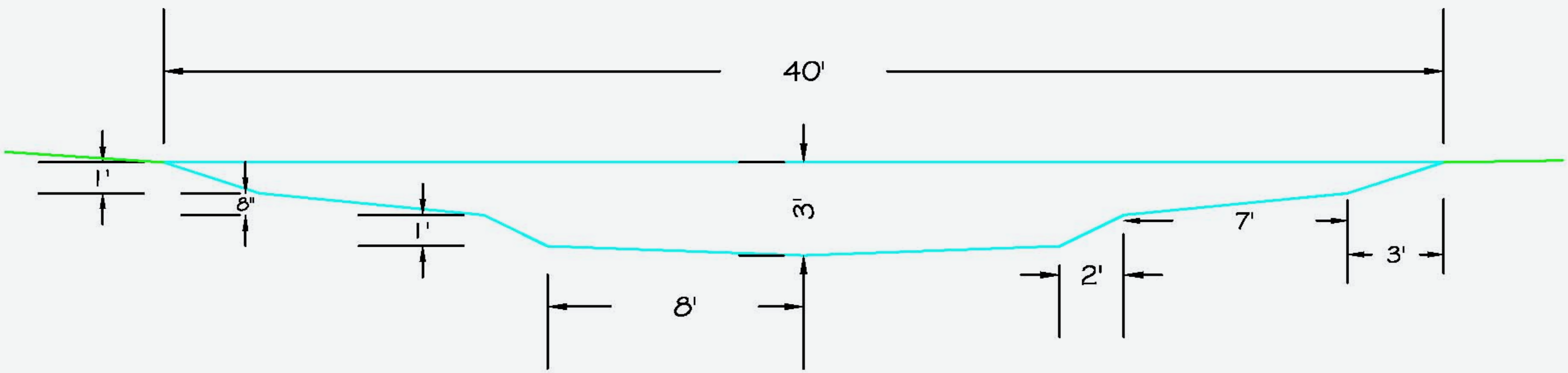
WEST BROOK ROUND IX (PHASE I PLAN VIEW)



WEST BROOK ROUND IX (PHASE II PLAN VIEW)



West Brook
Channel Cross Section



Not to Scale


EXIT 55
07-23-09


08/19/2009

West Brook – After

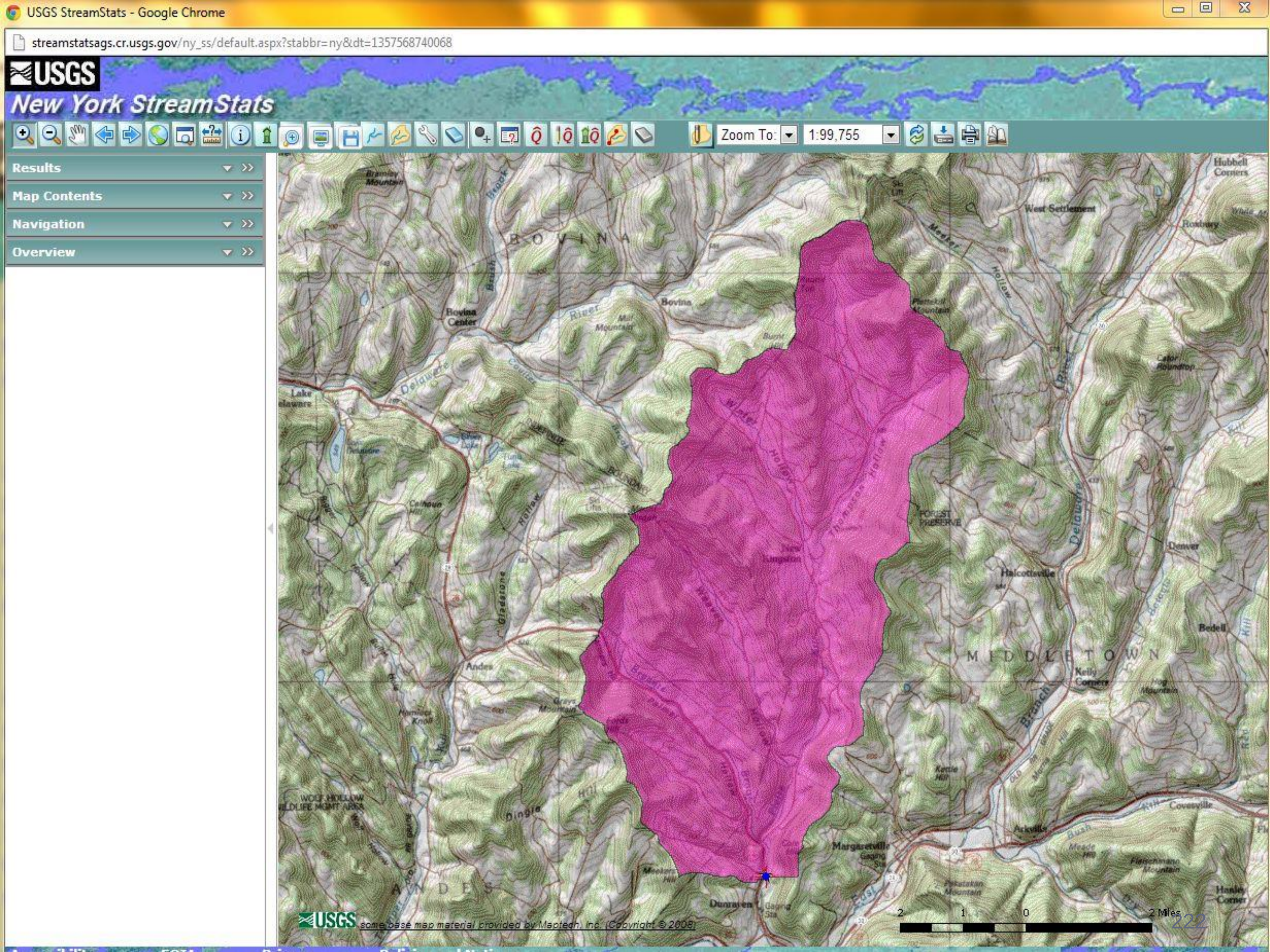

08-10-11


08-10-11

Platte Kill – Before


3-16-09


3-16-09


USGS StreamStats - Google Chrome
streamstatsags.cr.usgs.gov/ny_ss/default.aspx?stabbr=ny&dt=1357568740068
USGS
New York StreamStats
Zoom To:
1:99,755
Results
Map Contents
Navigation
Overview
BOVINA
Bovina Center
Bovina
MIDDLETOWN
Halcottsville
Andes
Margaretville
Dunraven
West Settlement
Roxbury
Denver
Bedell
Kelly Corners
Arkville
ANDES
Delaware
FOREST PRESERVE
some base map material provided by Maptech, Inc. (Copyright © 2008)
2 1 0 2 Miles

Note: This is Pro-rated not Averaged

Bank Full Region Grid Basin Characteristics

94% Bankfull Region 4a SIR2009 5144 (32 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	34.2	11.4	163

7% Bankfull Region 5 SIR2009 5144 (2.23 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	34.2	0.7	332

Bank Full Region Grid Streamflow Statistics Area-Averaged

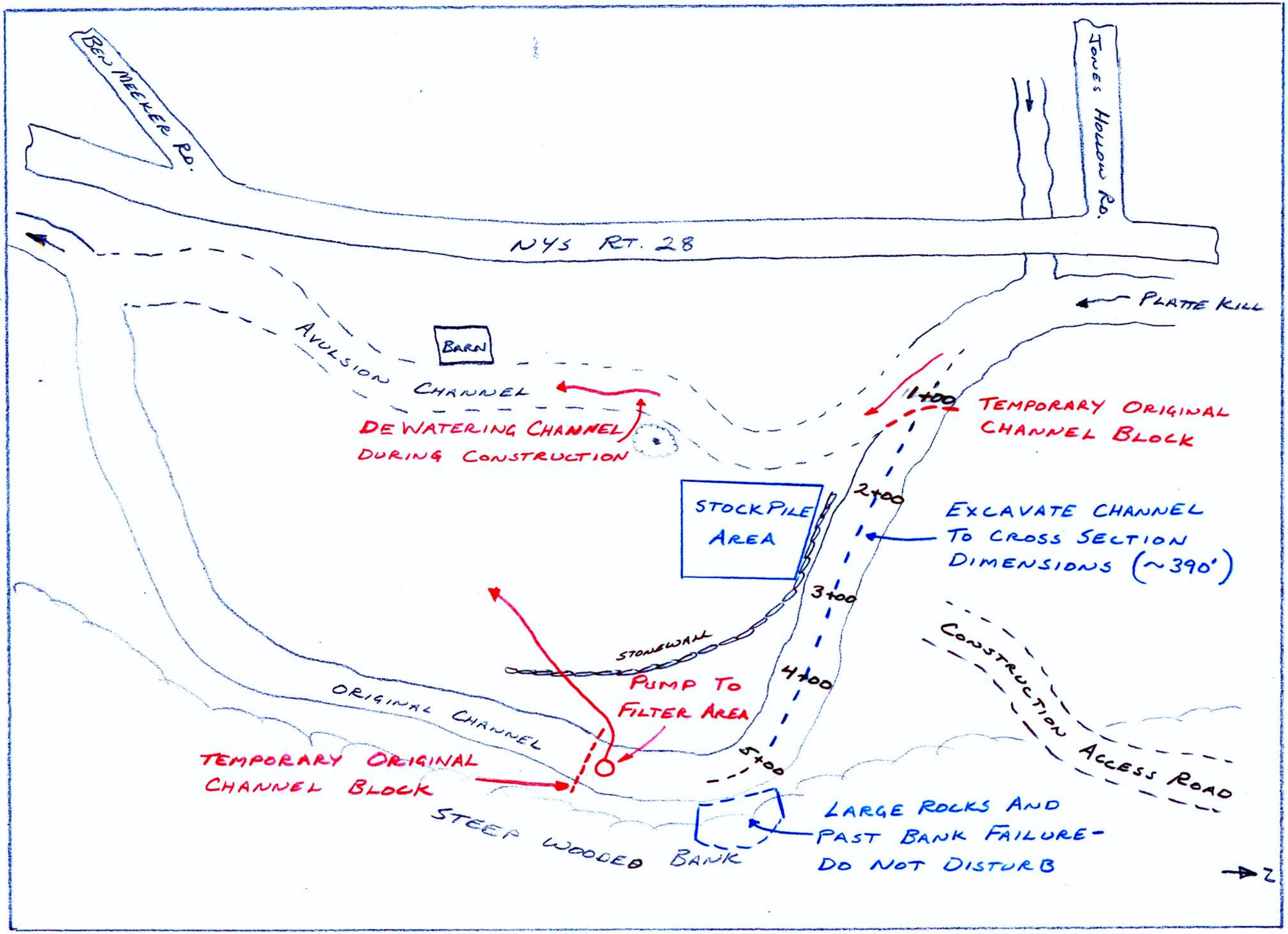
Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record
BFAREA	171	18	
BFDPTH	2.74	14	
BFFLOW	963	17	
BFWDTH	62.6	11	

Bank Full Region Grid Streamflow Statistics Bankfull Region 4a SIR2009 5144

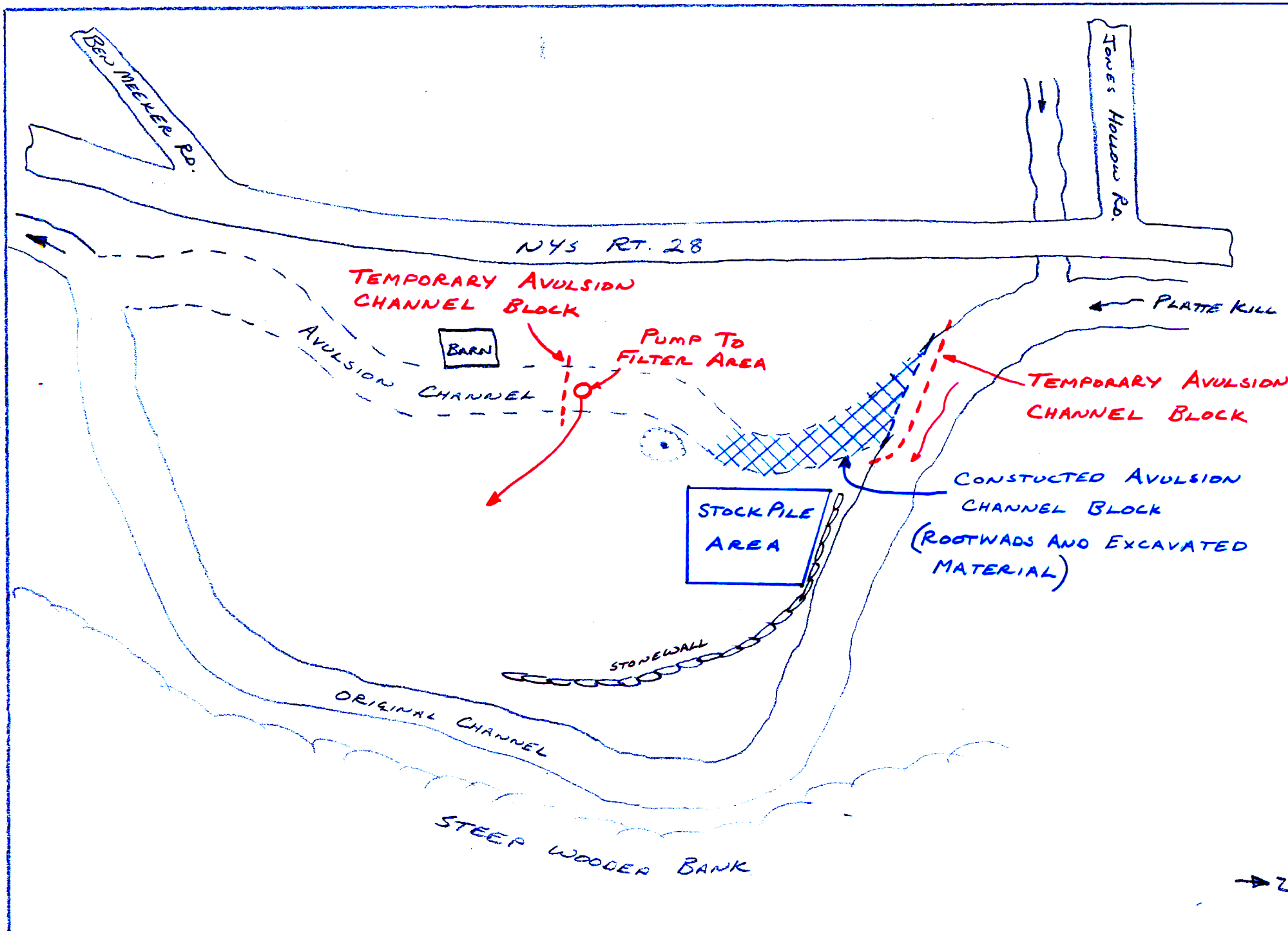
Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	169	18		36	796
BFDPTH	2.72	14		0.59	12.6
BFFLOW	966	16		31.7	29400
BFWDTH	62.4	10		13.7	285

Bank Full Region Grid Streamflow Statistics Bankfull Region 5 SIR2009 5144

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	198	24		103	380
BFDPTH	3.06	20		1.65	5.7
BFFLOW	932	36		272	3190
BFWDTH	65.9	27		33.3	131

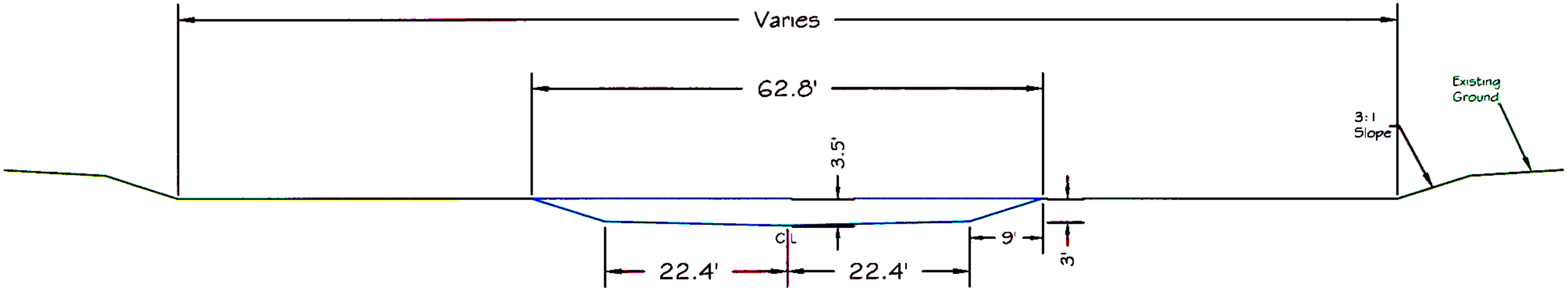

BEN MEEKER RD.
JONES HOLLOW RD.
NYS RT. 28
PLATTE KILL
BARN
AVULSION CHANNEL
DE WATERING CHANNEL DURING CONSTRUCTION
1+00
TEMPORARY ORIGINAL CHANNEL BLOCK
2+00
STOCKPILE AREA
EXCAVATE CHANNEL TO CROSS SECTION DIMENSIONS (~390')
3+00
STONEWALL
4+00
CONSTRUCTION ACCESS ROAD
PUMP TO FILTER AREA
ORIGINAL CHANNEL
5+00
TEMPORARY ORIGINAL CHANNEL BLOCK
STEEP WOODED BANK
LARGE ROCKS AND PAST BANK FAILURE- DO NOT DISTURB
N

PHASE 1


Ben Meeker Rd.
Jones Hollow Rd.
NYS Rt. 28
Temporary Avulsion Channel Block
Pump To Filter Area
Barn
Avulsion Channel
Platte Kill
Temporary Avulsion Channel Block
Constucted Avulsion Channel Block (Rootwads And Excavated Material)
Stock Pile Area
Stonewall
Original Channel
Steep Wooded Bank
N

Phase 2

Platte Kill
Channel Cross Section




9-15-09

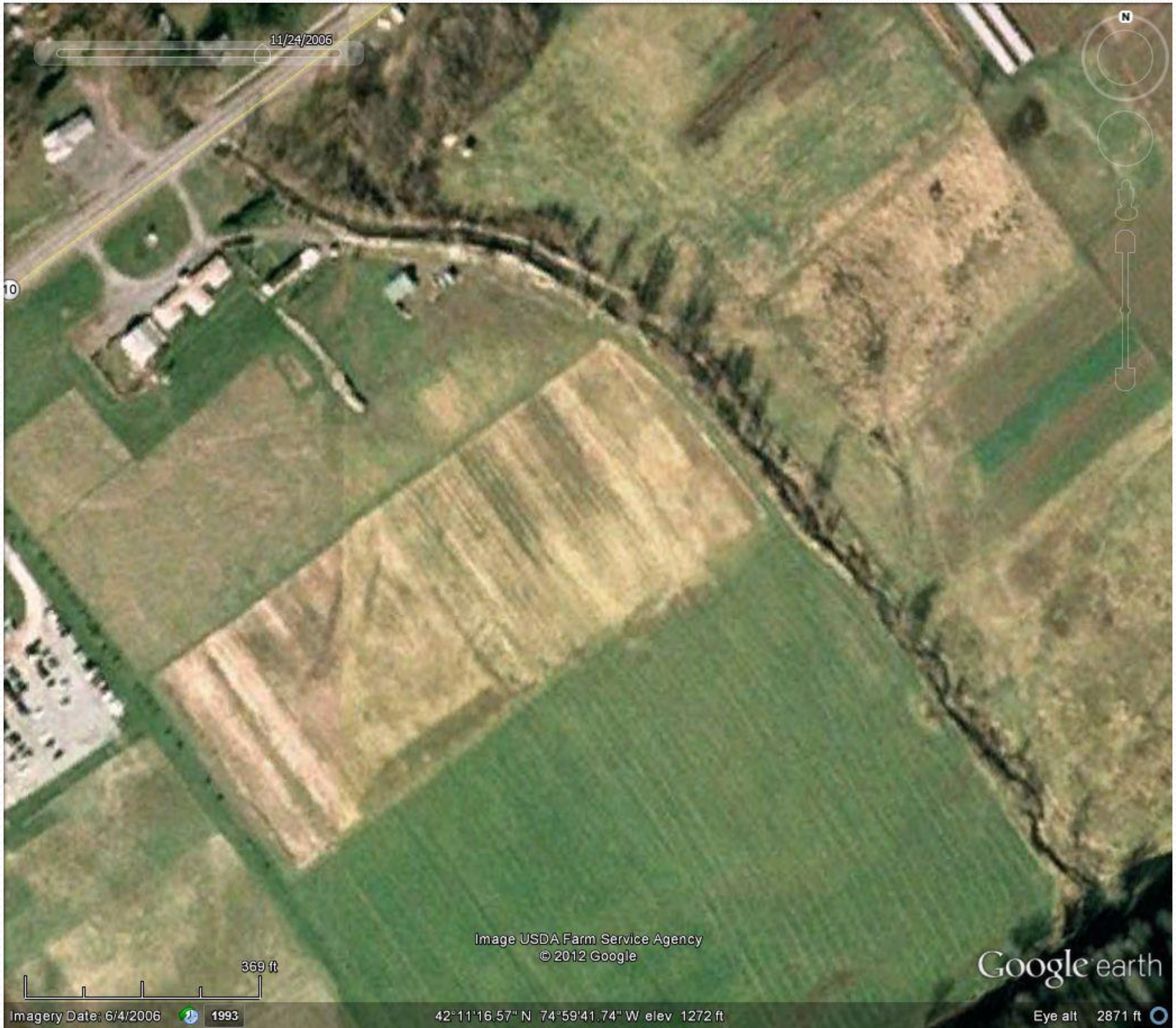

09/19/2009

Platte Kill – After


10-22-2012

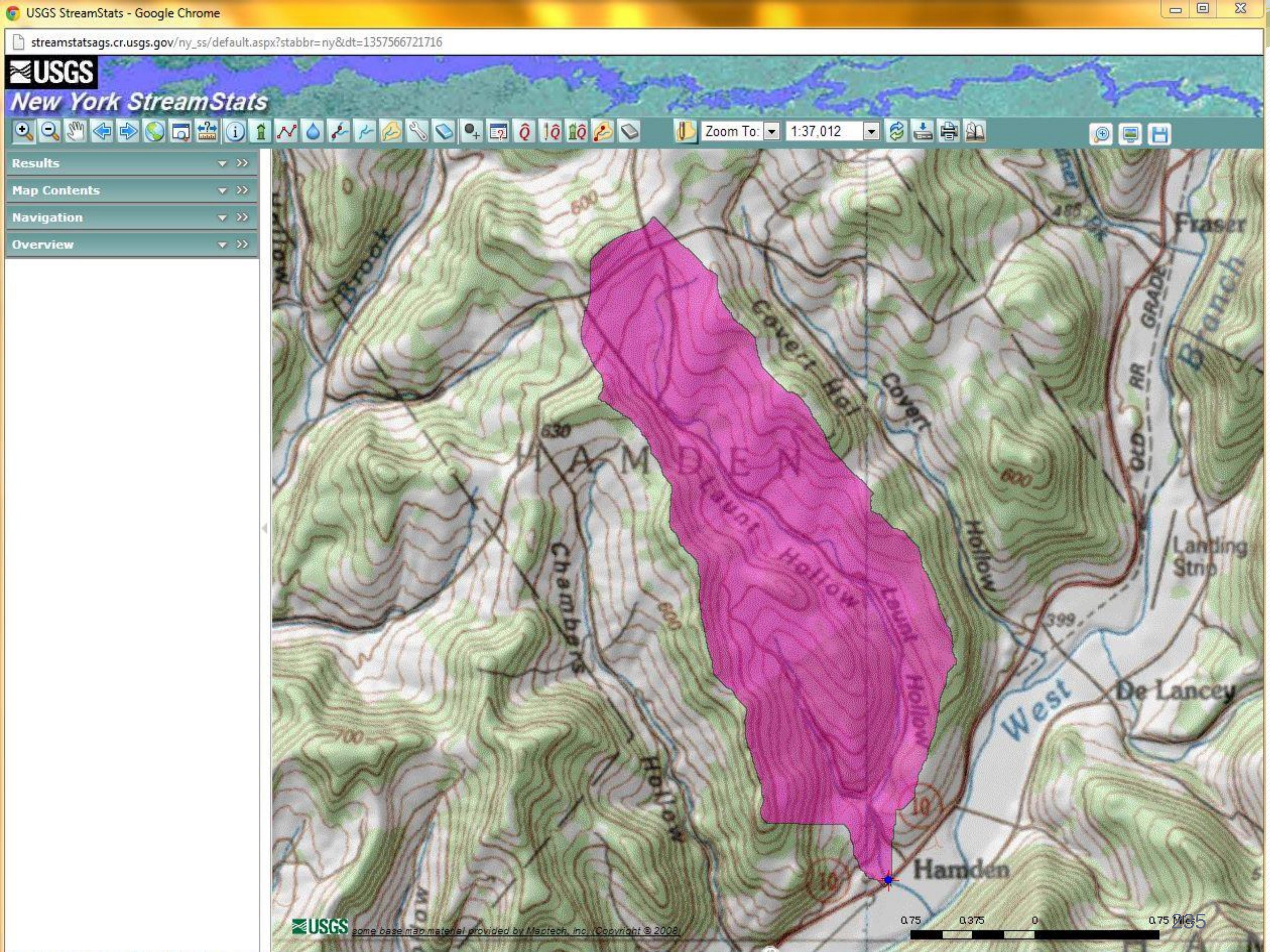

MAR 11 2011

Launt Hollow – Before




4-14-09


4-14-09


USGS StreamStats - Google Chrome
streamstatsags.cr.usgs.gov/ny_ss/default.aspx?stabbr=ny&dt=1357566721716
USGS
New York StreamStats
Zoom To:
1:37,012
Results
Map Contents
Navigation
Overview
HAMDEN
Launt Hollow
Launt Hollow
Covert Hol
Covert Hollow
Chambers
Hollow
Brook
West
De Lancey
Fraser
Landing Strip
OLD RR GRADE
Branch
Hamden
600
630
700
399
10
USGS
some base map material provided by Maptech, Inc. (Copyright © 2008)
0.75
0.375
0
0.75 Miles

Peak Flows Region Grid Basin Characteristics

100% 2006 Full Region 4 (3.95 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	3.95	0.61	3941
Slope Ratio NY (dimensionless)	0.17	0.006	0.438
Percent Storage (percent)	0.0264	0	7.75
Mean Annual Runoff in inches (inches)	23.9	19.84	26.09

Bank Full Region Grid Basin Characteristics

100% Bankfull Region 5 SIR2009 5144 (3.95 mi2)

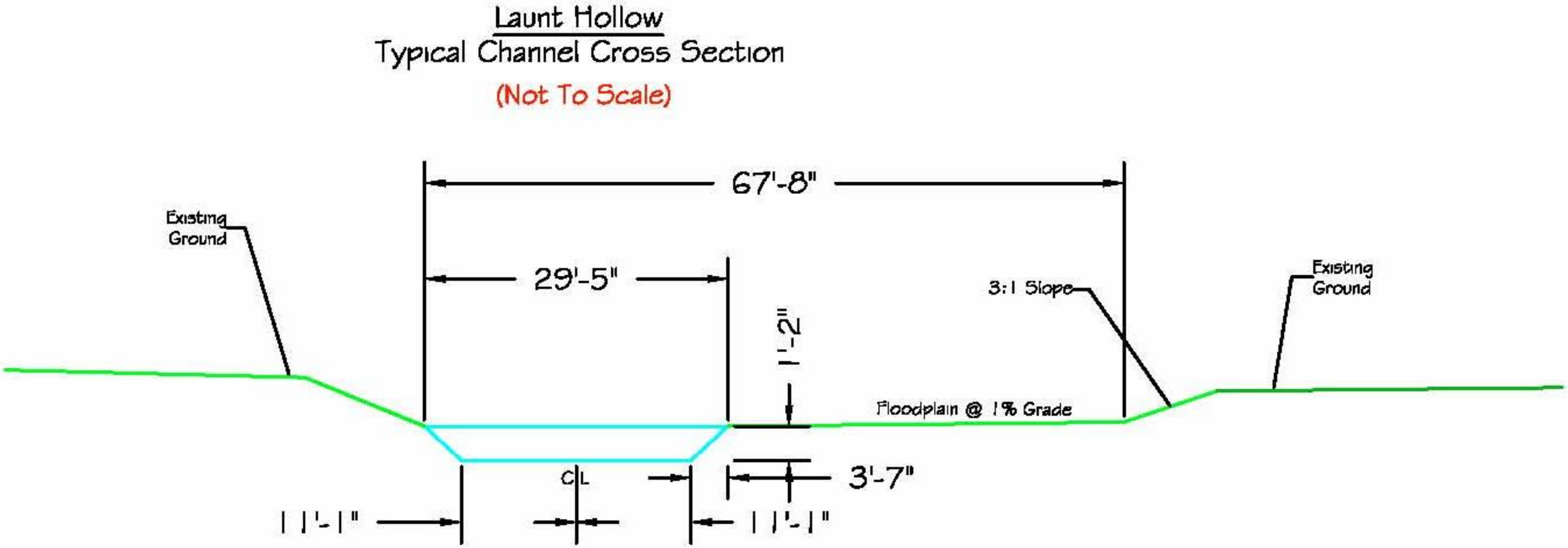
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	3.95	0.7	332

Peak Flows Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_25	141	29	3.1		
PK1_5	175	29	2.6		
PK2	219	28	2.5		
PK5	347	25	4.2		
PK10	442	23	6.5		
PK25	572	22	9.9		
PK50	675	22	13		
PK100	783	22	15		
PK200	894	22	17		
PK500	1050	22	19		

Bank Full Region Grid Streamflow Statistics

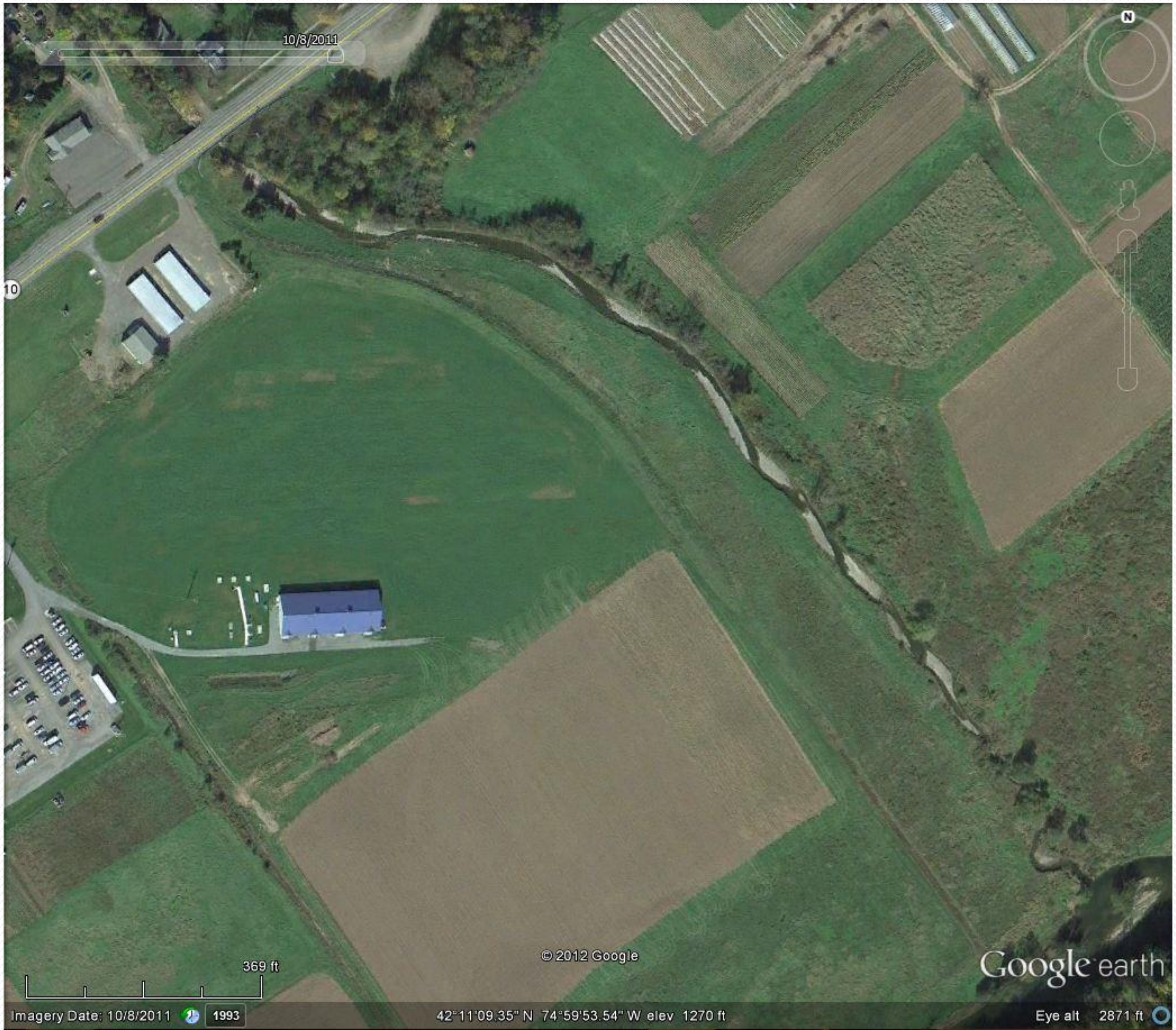
Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	33.5	24		17.3	64.5
BFDPTH	1.37	20		0.73	2.55
BFFLOW	147	36		34.4	626
BFWDTH	25	27		12.6	49.7


Launt Hollow
Typical Channel Cross Section
(Not To Scale)
67'-8"
Existing
Ground
29'-5"
1'-2"
3:1 Slope
Existing
Ground
Floodplain @ 1% Grade
CL
3'-7"
11'-1"
11'-1"


DEERE
9-02-09


9-10-09

Launt Hollow – After




10-20-09


10-27-09


10-29-09

Bioengineering Techniques

For Future Site Mitigation

List of Bioengineering Techniques

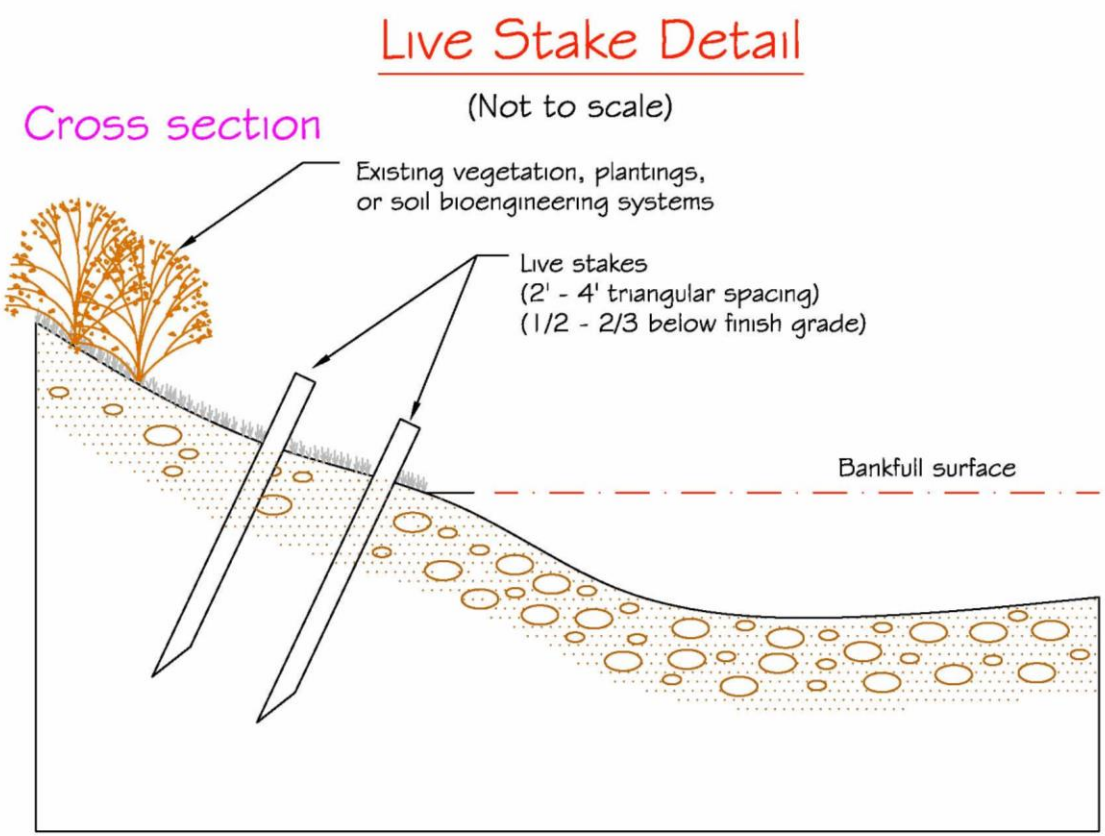
- Live Willow Stake
- Rip-rap Joint Planting
- Coconut Fiber Roll
- Live Fascine
- Brush Mattress
- Brush Layering
- Vegetated Geogrid
- Live Cribwall

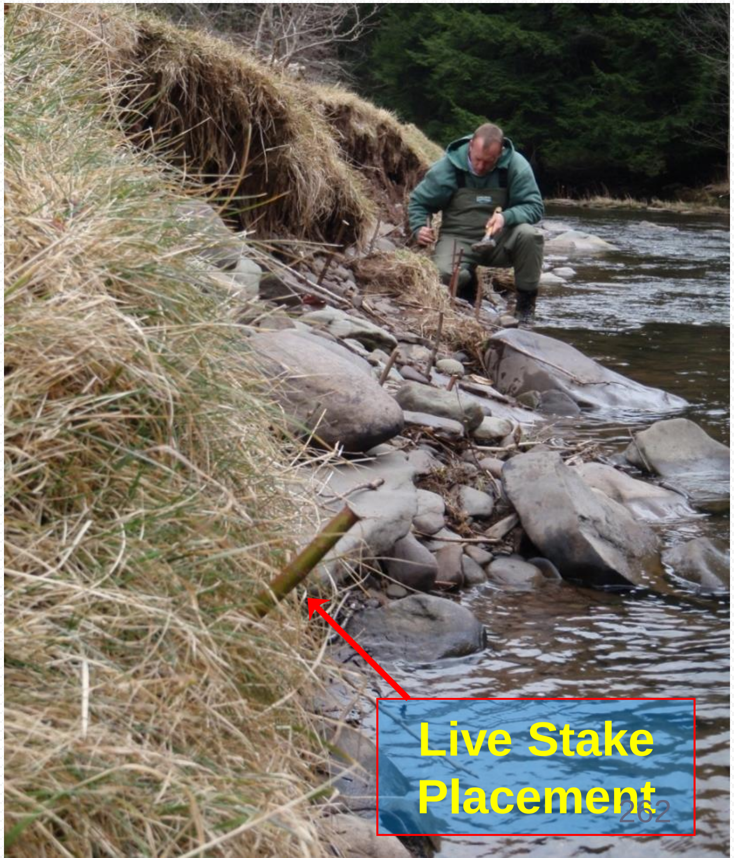
Multiple techniques are often used together to produce a final solution.

* Reference: Details and pictures are from U.S Department of Agriculture Forest Service – A Soil Bioengineering Guide: for Streambank and Lakeshore Stabilization

Live Willow Stakes

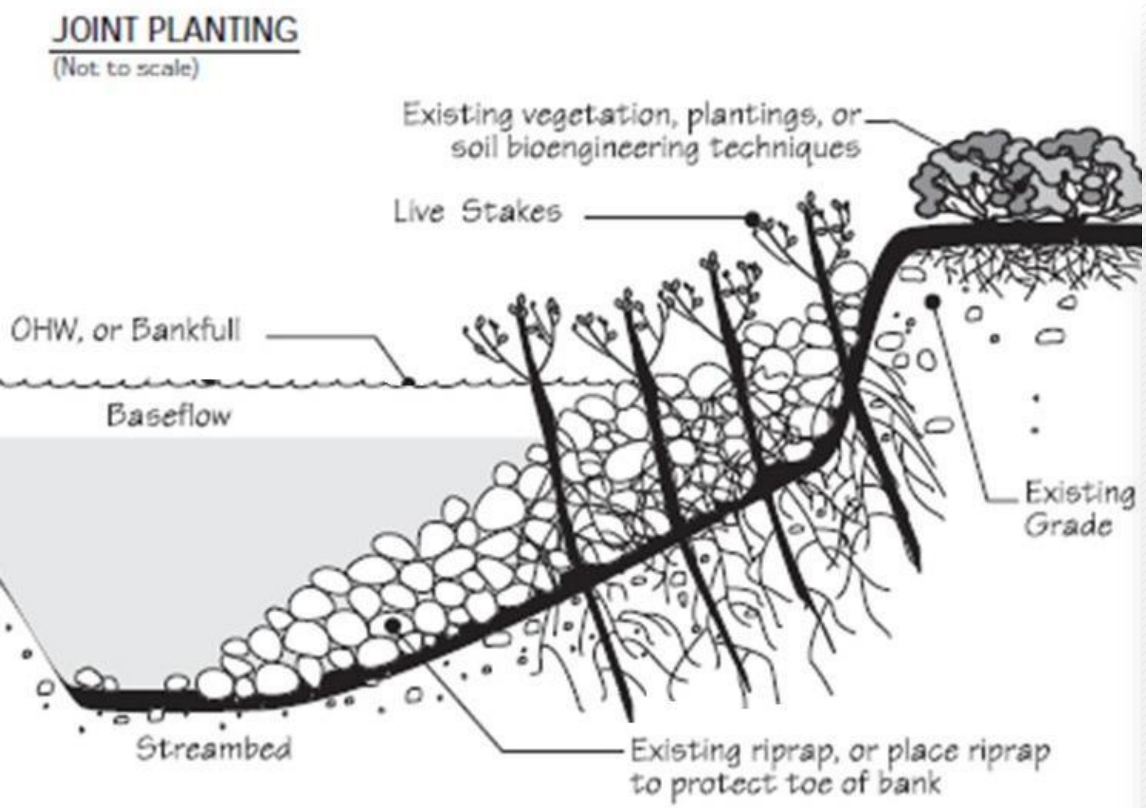
The placement of dormant woody plant cuttings into the bank as a method of stabilization by the root and above ground growth.





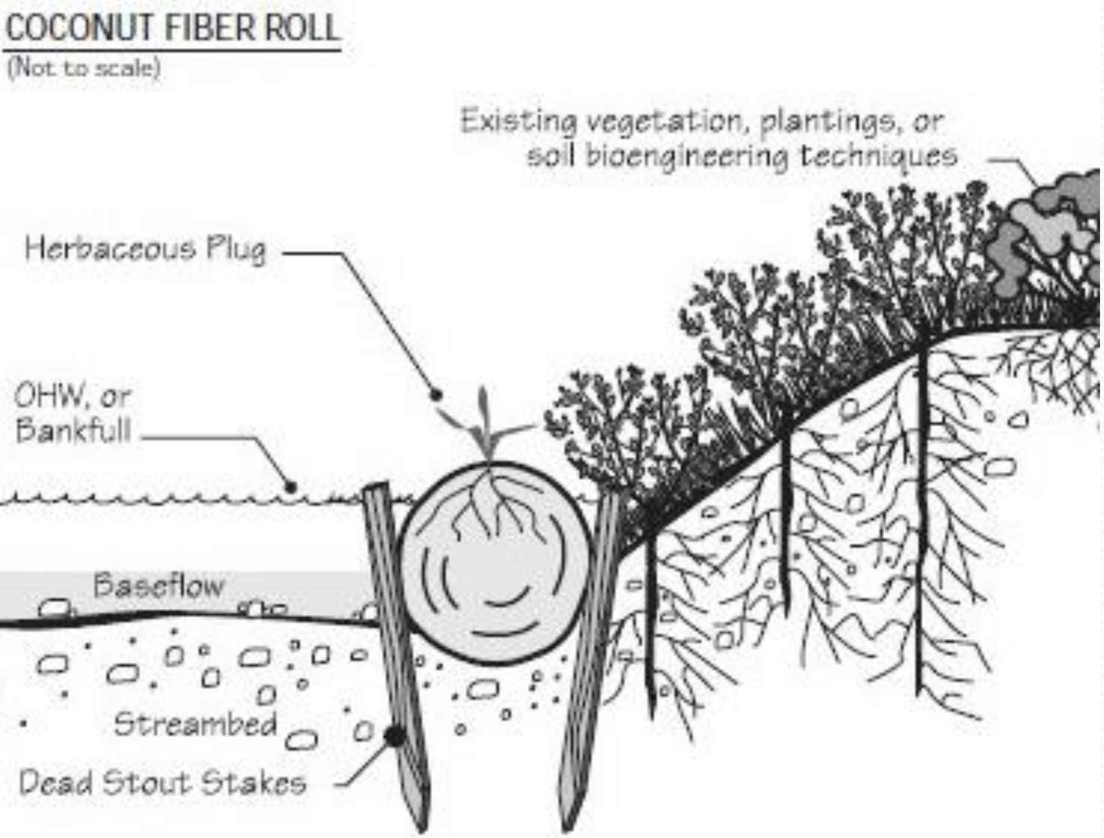
Rip-rap Joint Planting

Disguises and shades riprap, provides habitat and adds additional stabilization to streambank. Can be installed in open spaces between existing rocks or when rock is being placed. Material should be 1.5 inches or larger in diameter.



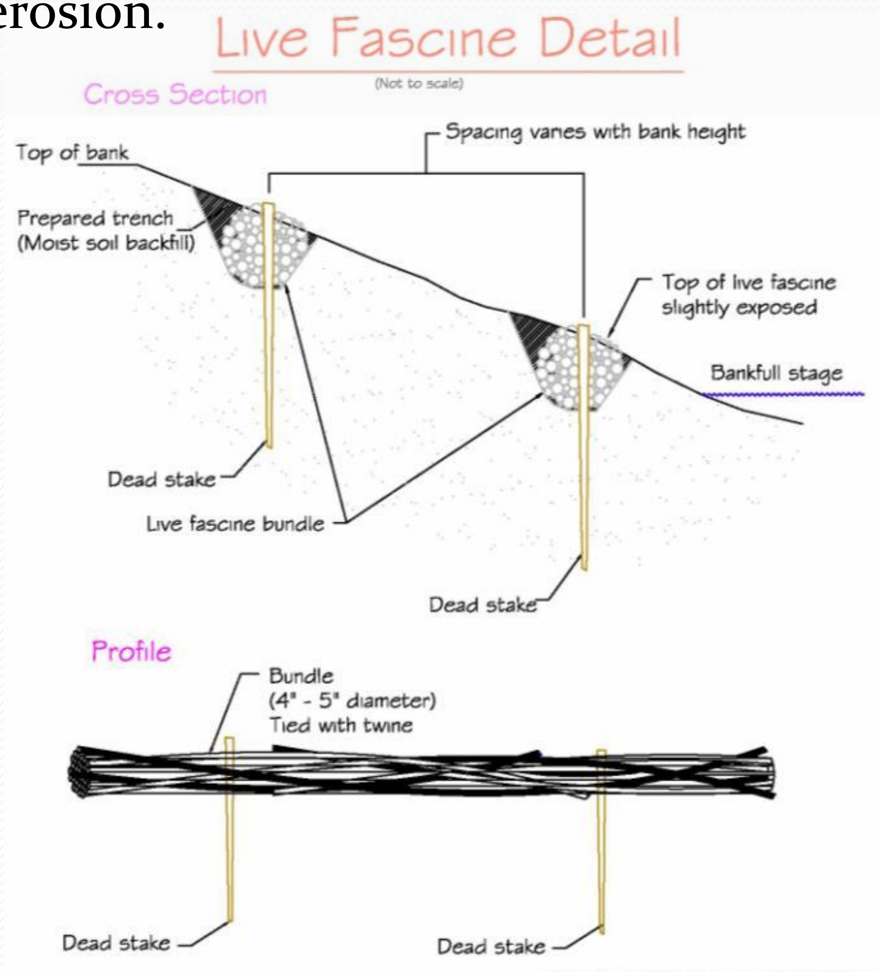
Coconut Fiber (Coir) Roll

Used on hillsides and low-gradient streams and waterbodies to protect the slope and toe. Can conform to bank contour and allows plants to grow in it.



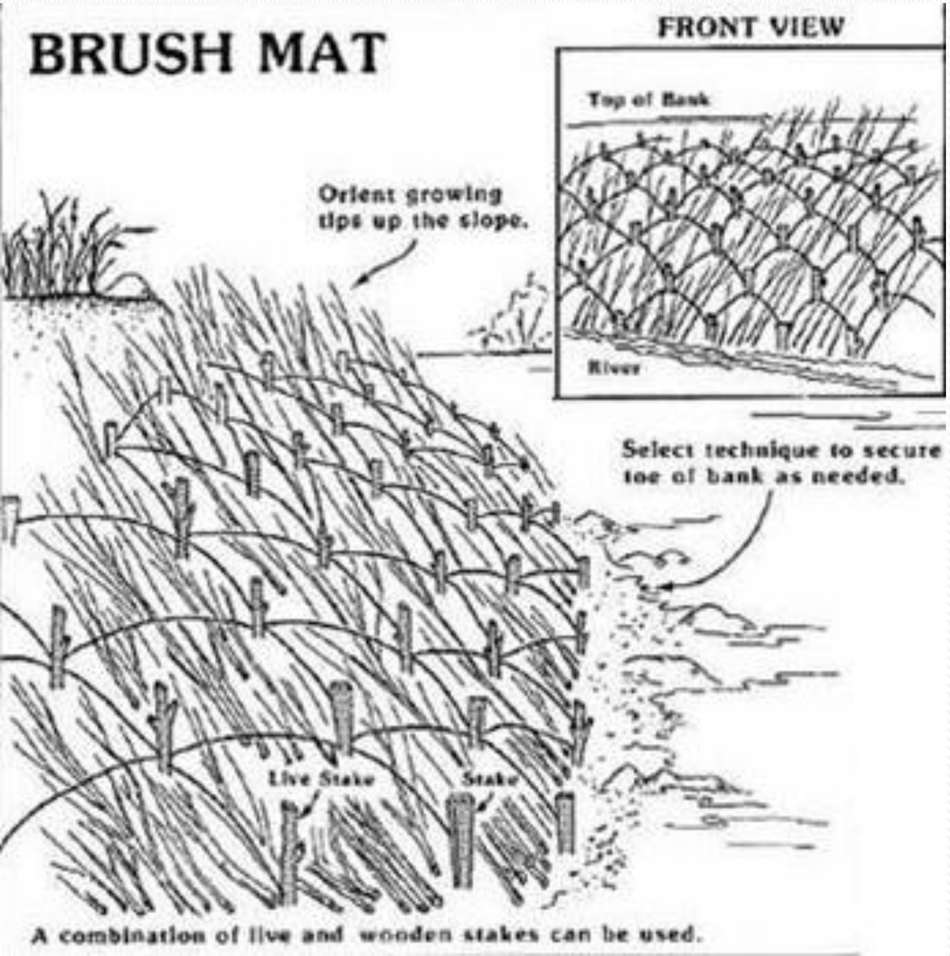
Live Fascine Placement

Bundles of live branches placed in trenches on the streambank to protect the toe of streambank, trap sediment, reduce slope steepness, and slow surface erosion.



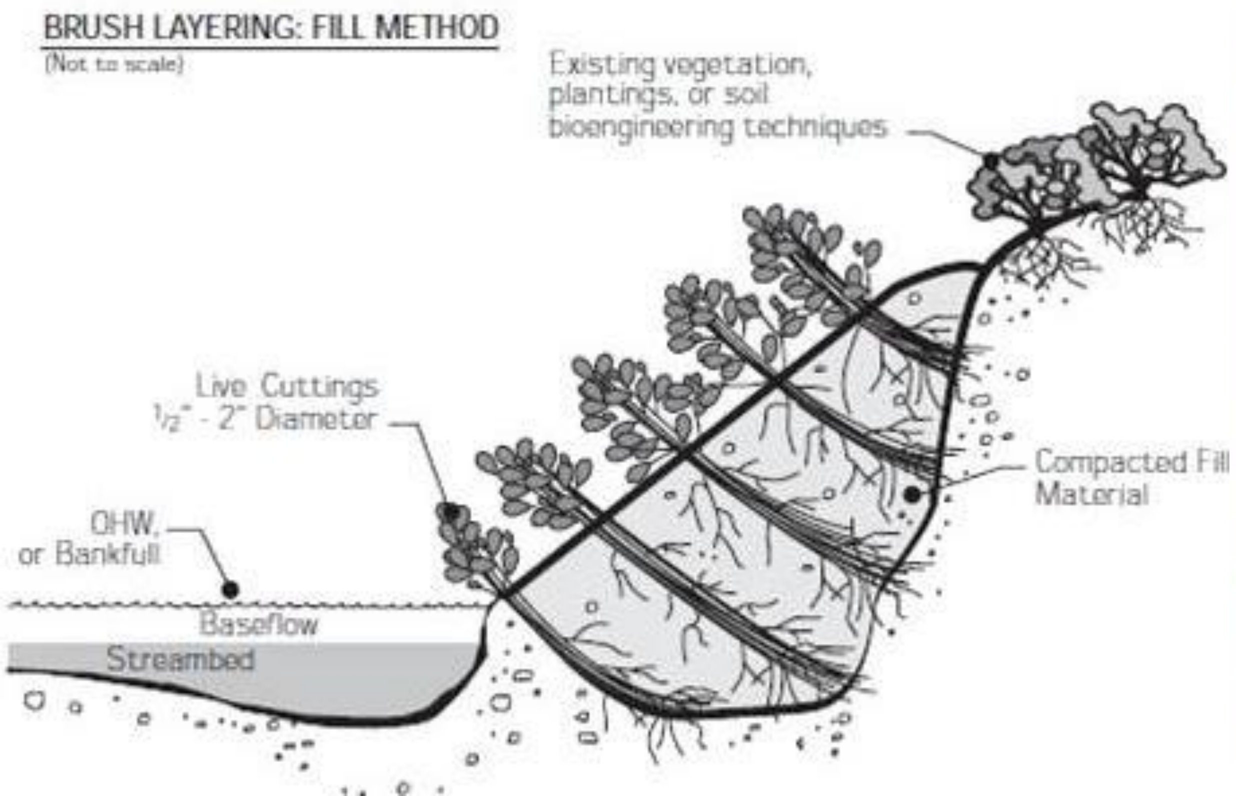
Brush Mattress

A layer of dormant branches laid on and secured to a bank surface offering an immediate bank coverage. Typically, it is combined with a toe stabilizing technique such as rock, root wads, live siltation, fascines, coconut fiber logs, or tree revetments.



Brush Layering

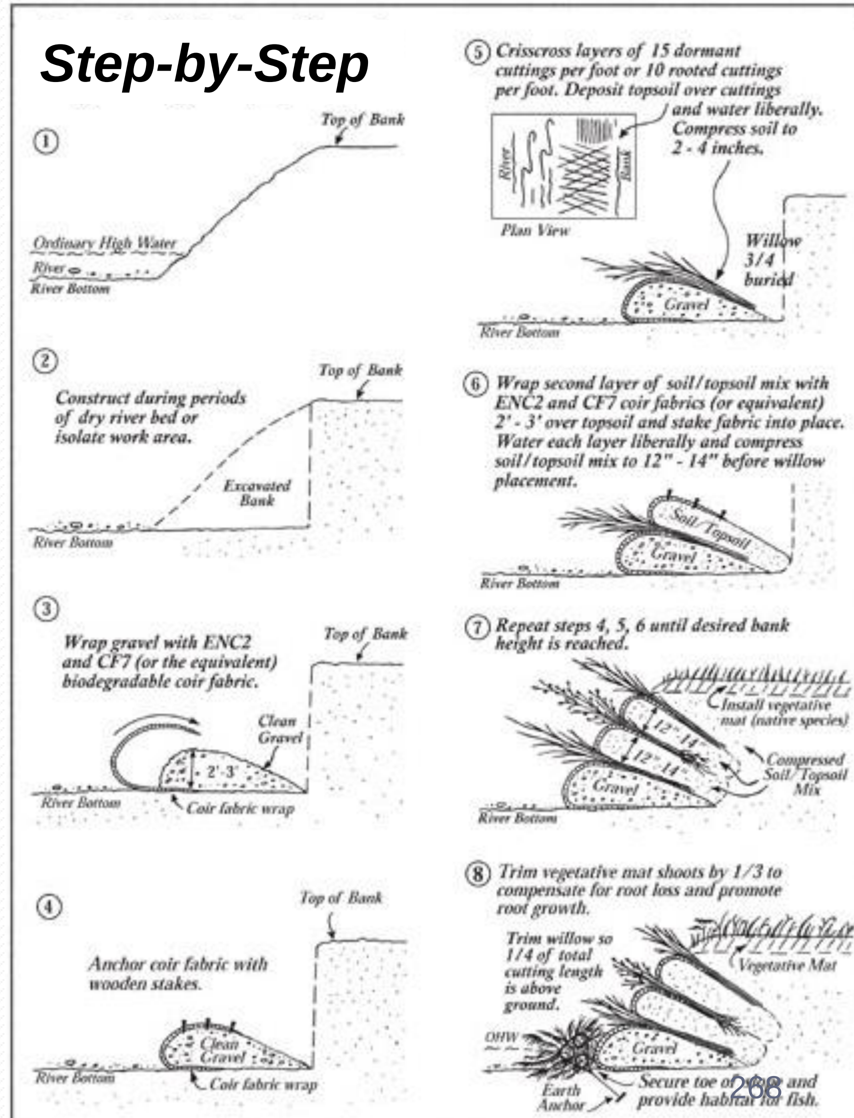
Laying vegetative cuttings on horizontal benches that follow the contour of either an existing or filled bank (slope).



Brush layering with coconut logs.

Vegetated Geogrid

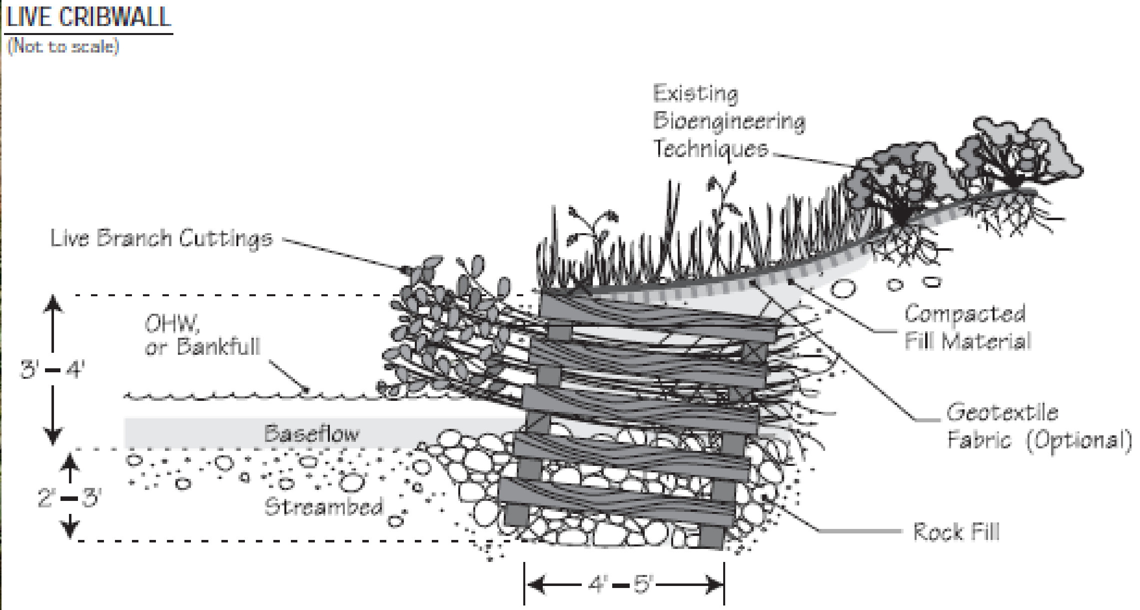
Similar to Brush Layering plus erosion control fabric to wrap the soil between the layers. Live cuttings are placed between the geogrids, and a root structure is established to bind the soil within the geogrid. Can be used on severely eroded slopes up to 8 feet in height where the bank cannot be pulled back to a gentle slope.




7-03-08

Crib Wall

A live crib wall is used to rebuild a bank in a nearly vertical setting, but can also be tiered to create a less steep slope. It consists of a boxlike interlocking arrangement of untreated log or timber members. The structure is filled with rock at the bottom and soil beginning at the ordinary high-water mark or bankfull level. Layers of live branch cuttings root inside the crib structure and extend into the slope.



Hydraulic Structures

For Future Site Mitigation

- These structures are made of rocks or logs
  - Barbs & Rip Rap
  - Cross vanes
  - Straight vanes
  - J-hooks
  - Step-pools
  - Hardened Riffles

- If you think you need to install one or more of these contact your local SWCD or NYS DEC office for assistance

Barbs & Rip-Rap

Cross Vane

Straight Vane

J-Hook

Step-pool

Hardened Riffle

Hardened Riffle

USC Contact Information

Tioga Soil and Water Conservation District
183 Corporate Drive
Owego, New York 13827
Phone: (607) 687-3553
Fax: (607) 687-9440
web site – http://www.u-s-c.org

Wendy Walsh – USC Watershed Coordinator - WalshW@co.tioga.ny.us
Mike Lovegreen– Stream Team Leader – mike.lovegreen@u-s-c.org
Melissa Yearick – Wetland Program Team Leader – Melissa@u-s-c.org
Jeff Parker – USC Chair/Steuben SWCD Manager – jgparker@stny.rr.com

Credits

Soil and Water Conservation District
Steuben County

U.S. Fish & Wildlife Service
Department of the Interior

Department of Environmental Conservation
New York State

Emriver Geomodels

info@emriver.com
618-529-7423

Delaware County
Est. 1946
Soil & Water Conservation District

Upper Susquehanna Coalition

Questions?